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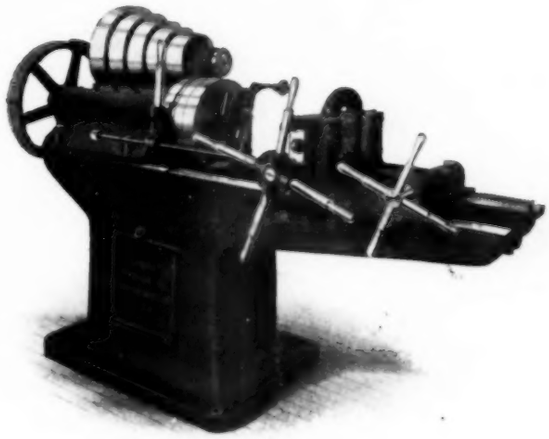

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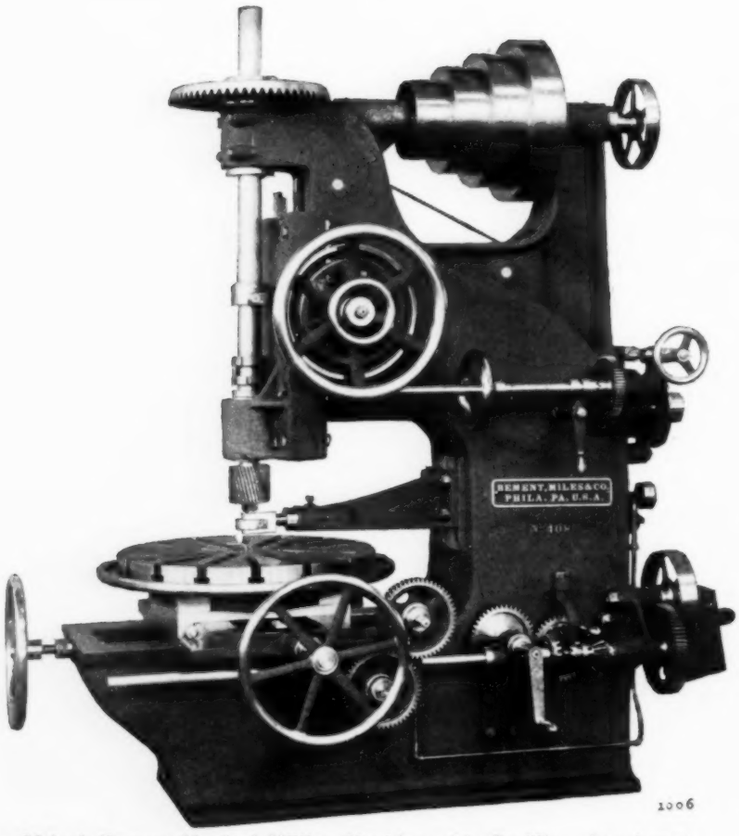

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(*See pages* 43, 44, 45, 46, 47 *and* 48)

Foundry for Casting Transformers

Editorial Correspondence

A foundry equipped with individual electric cranes, grates on which to dump the molds so the sand will fall to the cellar, there to be cut over and conveyed by elevators back to molders' floor, so it can be kept in continuous use.

Methods used in making the molds and cores, and the apparatus used for continuously pouring them after the first few molds have been set up.

The new foundry of the General Electric Company, at Pittsfield, Mass., an interior view of which is shown in Fig. 1, has many novel features that are worthy of mention. The changes and improvements that have been taking place in the foundry business in the last few years are revolutionizing that industry so that the modern foundry, properly equipped, is enabled to produce castings at a fraction of the cost of the old style foundry that relies on skilled hand labor alone.

As will be seen in Fig. 1, the gangway has a double track with numerous crossovers, for moving about the flasks and molds, and for bringing the molten metal in ladle cars to the molders' floor. In the lower right-hand corner will be seen a grate on which the molds are dumped so the sand will pass through to the basement and leave the castings clear of the molding sand. One of these is located on each molding floor.

Each molders' floor is also supplied with an individual electric crane for handling the different parts of the mold, setting the cores, etc. Inside the wooden boxes marked *C D*, etc., down each side of the room are the bucket elevators that bring the sand up from the basement. Stripping plates are used to a large extent as well as molding machines of various types.

Sand House and Dust Collector

In Fig. 2 is shown the new sand house. This is a brick and concrete building that is placed alongside of the foundry building and detached from it. A railroad track has been placed in the center of the building so that the cars can be run inside and the sand transferred direct to the numerous bins in which it is stored. From the storehouse the sand can be sent down a chute to the basement of the foundry in which it is prepared for the molders and conveyed to their respective floors.

Alongside of the sand house is shown the dust collector. Dust enters this collector through the pipe that comes out of the basement window, where the casting-cleaning room is located; the castings being cleaned in one end of the basement. From this main pipe, numerous branches are diverted to various parts of the cleaning room.

As will be seen, a track is laid under the collector. Special cars are run on this track, under the three spouts with which the collector is supplied. The dust, dirt and waste material are then dropped into this car which, when filled, is wheeled to the dump.

In Fig. 4 is shown a section of the basement; one of which is under each box marked *C D*, etc., in Fig. 1. Here the sand is cut over and prepared for the molders' use and shoveled into the pits. The bucket conveyer then picks it up and carries it to the molders above.

Molders' Floor

A typical view of one of the many molders' floors is shown in Fig. 3. At *A* is located the grate on which the molds are shaken out. They are built up on

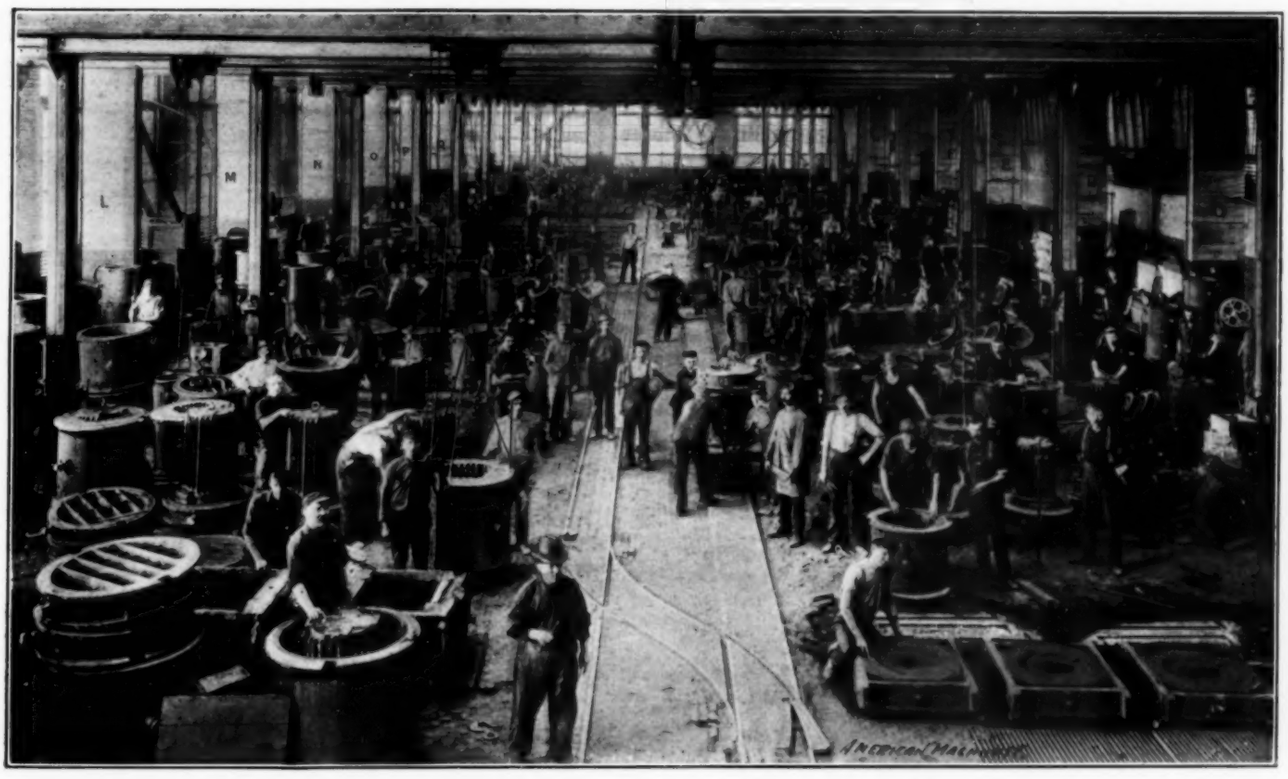

Fig. 1. New Foundry of General Electric Company, at Pittsfield, Mass.

FIG. 2. NEW SAND HOUSE AND DUST COLLECTOR

each side of the grate. At *B* is located the box in which the bucket conveyer brings the sand from the basement. The sand drops out of the chutes like the one shown at *C* and piles up on the bench ready for the molder to use.

At *D* is shown the individual electric crane; one of which is located on each molders' floor. It is shown as it is lifting up the drag part of the mold, on which has been molded the green-sand core. The switch for turning on and off the current is shown on the wall at *E*, and the handle for operating the crane is shown at *F*.

By turning this handle to one position the crane can be made to move lengthwise of the molders' floor, which would be across the shop, on the beams shown overhead. By moving the handle to another position the crane is made to travel across the molders' floor. Thus the crane will handle work in any part of the space between the two overhead beams for the entire width of the shop. If two cranes are required to handle an extra heavy piece, it can be run across the shop and used in conjunction with the one on that side.

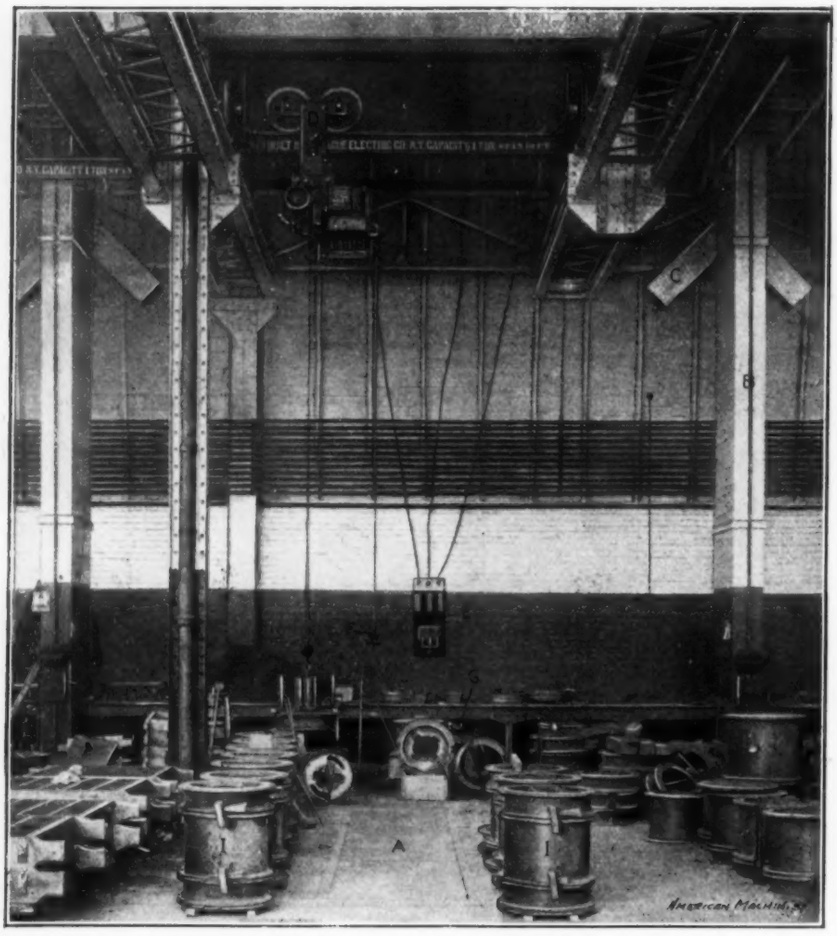

FIG. 3. INDIVIDUAL MOLDER'S FLOOR

MOLDING METHODS

In Fig. 5 is shown the method of molding the pattern. A large part of this work is made in three-part flasks and the illustration shows the pattern as it has been rammed up in the cheek, the part-

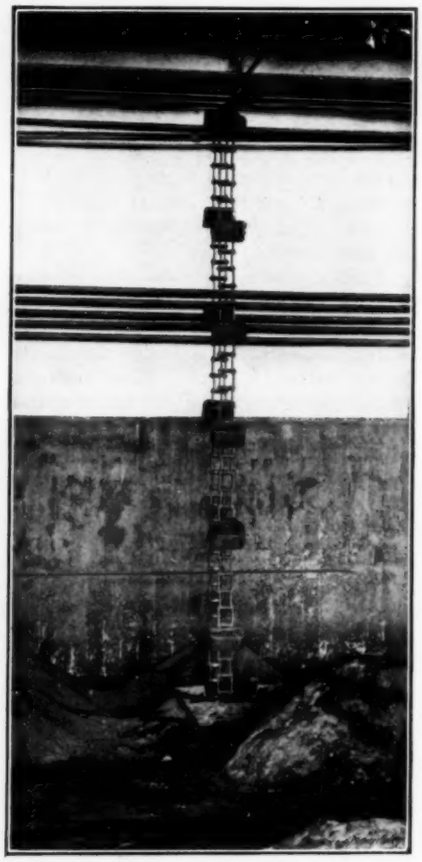

FIG. 4. ELEVATING SAND FROM BASEMENT

ing made, the cope rammed up and lifted off ready to draw the pattern. The cheek of the mold is located over a pit and on top of this pit the pattern is located on a stripping plate.

When the ramming is completed in this case, the pattern is drawn down through the stripping plate and out of the bottom of the cheek by turning the handle *G*. The location of this pit on the molders' floor can be seen by the same handle, also marked *G* in Fig. 3. There the cheek has been turned on its side on the box and the cope has been rolled over against a finished mold.

GREEN SAND CORE

While the molder has been ramming

up the pattern in the cheek and cope, the helper has been ramming up the core, which is made of green sand, in the drag of the mold. After this core has been rammed up and turned over, and the core box lifted off by the individual crane, it is ready to lower the check onto. The core box, just as it has been lifted off, leaving the green sand core in the drag, is shown in Fig. 8.

After the core box has been lifted off the drag, two long rods are placed in the holes in the flange of the flask and these guide the cheek to its proper position as it is being lowered upon the drag, by the individual crane, as shown in Fig. 7. After the cheek has been clamped into position, the cope shown at *H*, in Fig. 5, is located on top of it and clamped as shown by the molds *I*, in Fig. 3, which are ready to pour.

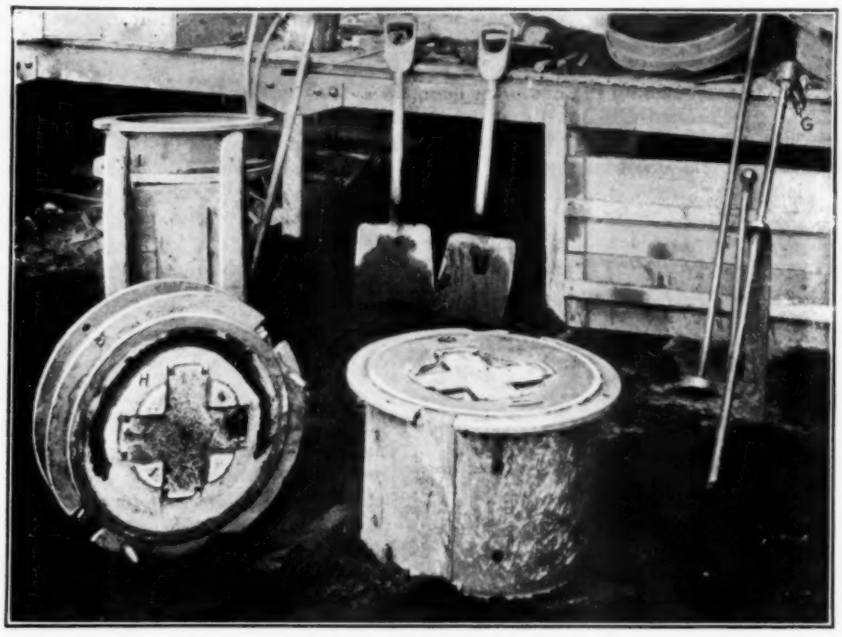

FIG. 5. MOLDING PATTERN IN CHEEK ON STRIKING PLATE

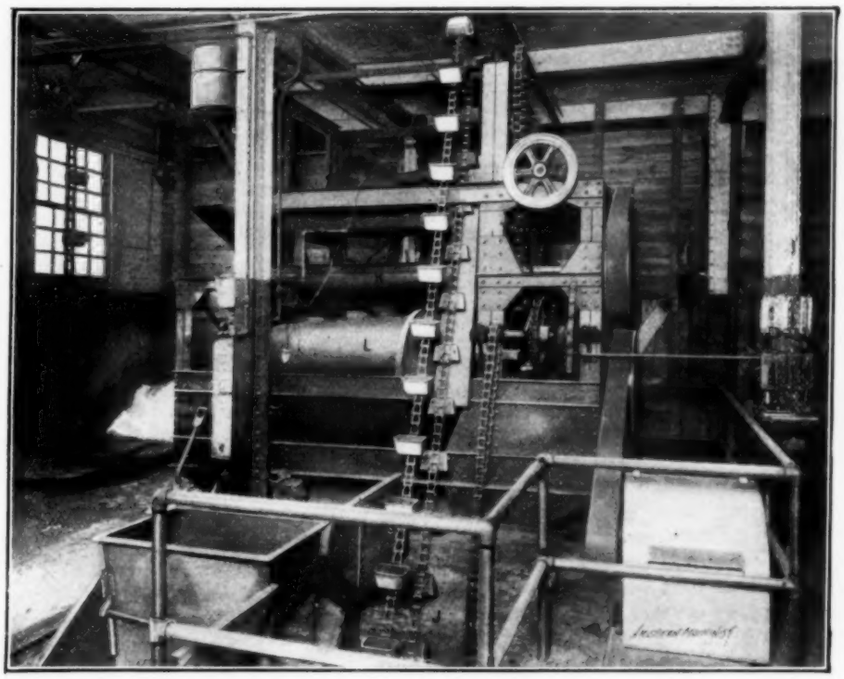

FIG. 6. CORE SAND MIXER AND ELEVATORS

CONTINUOUS POURING

As soon as enough molds are prepared in the morning for pouring, the hot metal is brought to the molders' floor by the

FIG. 7. LOWERING CHEEK OVER GREEN SAND CORE

FIG. 8. STRIPPING OFF THE GREEN SAND CORE BOX

ladlemen, in ladle cars, and the pouring is kept up continuously for the rest of the day. This is due to the fact that the molds can be shaken out as soon as the metal solidifies, when the sand immediately drops to the basement out of the molders' way and the castings are immediately removed to the cleaning room. This leaves the floor cleaned and the flasks ready to start building other molds without any time being lost. The sand falling into the basement, being cut over and elevated to the molders' bench, it is used over and over again during the day.

Mixing Core Sand

At the end of the foundry is located the core room and the core sand is all mixed in the basement and conveyed to the core-room floor the same as the molder sand. The basement, however, is partitioned off so that the molders' and coremakers' sand will not get mixed and the dust from either part affect the other. The core sands are all cleaned and mixed in the special machine shown in Fig. 6. The sand, as it comes from the sand-house, is dumped onto the basement floor and then shoveled into the pit at *J*. It is there picked up by the buckets and conveyed to the top of the machine, where it is dumped onto a vibrating screen. This screens out all of the coarse gravel or foreign substances that might be in the sand. After this it is moved through the half-round steel tank *K*, by revolving spirally set knives that cut it up and mix it with the binders, compounds or other materials that may be desired and from there it is dumped into the upper end of the inclined retort *L*. There it is ground up thoroughly, mixed and dropped into a bin from which it is picked up by the buckets and conveyed to the coremakers' floor.

By this means a core sand is obtained that is more evenly mixed, more uniform in size, and freer from foreign substances or pebbles than any of the sands that are mixed by hand. With the exception of one man to see that this special machine is fed properly, the work of mixing the sands is done entirely automatically.

Notes on the Coöperative System*

By Herman Schneider†

This system in the business of training engineers has a tremendous reflex action for good on the university, has brought about a co-ordination of courses never possible before and is found to stimulate the scientific spirit in the students. The alternate week plan is not fundamental but is merely a detail.

*Presented at the annual convention of the Society for the Promotion of Engineering Education.

†Dean of the College of Engineering, University of Cincinnati.

It is difficult to formulate a simple comprehensive statement of the principle underlying the coöperative system. Various attempts have been made to condense it into one sentence, as, for instance, "Hitching the school and shop abreast, rather than in tandem;" "combining theory and practice." In former papers, this statement has been used: "The practical side of engineering, that is, the technique, can be learned only in a shop working under commercial conditions, and the theory underlying the technique can be taught only in a school by skilled teachers." Perhaps the best statement of the fundamental idea is this: "The practice of engineering cannot be learned in a university; it can be learned only where engineering is practised, namely, in the shop or field. The theory underlying the practice may be obtained outside of the university, but can be best obtained in an organized system of instruction under skilled teachers."

It should not require much argument to show that the practice and the theory underlying it should be taught simultaneously, if possible. As a matter of fact, the whole argument for the coöperative course, together with the investigation which led to it, would make a long and involved statement, and while it might prove more conclusive than any simple expression, we have always felt that the demonstration of the scheme, together with a statement of the results achieved year by year, would be more effective. While we still believe the actual demonstration to be better than the argument, we find that many erroneous impressions prevail concerning our work.

Alternate Week Arrangement Merely a Detail

Curiously enough, many people think that the basic idea in the coöperative system is the alternate-week arrangement. The plan by which theory and practice are combined and coördinated is merely a detail and the alternate-week scheme which we use is the one which happens to fit our local conditions the best. Even in our own school we are devising different systems of coöperation.

For instance, after four years of experiment we have decided to operate the coöperative courses in electrical, mechanical and metallurgical engineering on the alternate-week plan 11 months in the year, reducing the length of the courses from six years to five years.

In civil enginering, we have the alternate-week scheme eight months in the year, and for the summer months we have made an arrangement with the Union Pacific Railroad Company, whereby our students obtain field work in railroading, together with instruction given by the railroad company. In chemical engineering there will be a marked departure, according to our present plans, from both of these details of operation.

It must be evident that for different localities, different means of getting theory and practice together will be used, and, also, in different courses the ratio of theory to practice will vary. For example, the University of Wisconsin probably could not operate on the alternate-week plan because of its distance from the factories of the State. It could establish a faculty in Milwaukee and have an alternate week or fortnight scheme; but if the faculty remained in Madison the plan would probably be to have eight months of instruction at Madison and four months of scheduled shop work with coördination in Milwaukee, using four rotating sections so that the shops would always have the same quota of student apprentices. Such a plan as this would be a coöperative scheme, of course, but would have a less amount of shop work, and in the opinion of some of our critics, would be a more beneficial arrangement than the one which we believe to be the best for our conditions in Cincinnati.

Further, in coöperative law, medical, commercial, agricultural, architectural or mining courses, it is evident that the amount and character of practice would vary greatly. I believe, and sincerely hope that there will be many forms of the coöperative system adopted by different institutions and out of all of these we shall probably get, by experiment, the best forms. I can readily see that some of the more conservative Eastern institutions will hesitate to tie up as intimately with commercial shops as we have done in Cincinnati. It is probable that they will adopt some form of the coöperative system with a less amount of outside practical work, making the work less rigorous, and devising their details so as to cause the least amount of disturbance to their present systems. Four years of experience in operating our coöpera-

tive courses, however, leads me to expect failure for any coöperative scheme which is not made commercially profitable for the shops, which does not start the student at the very bottom of the practice of engineering, which eliminates the hard work that the regular mechanics do or the regular hours they maintain, or which modifies the shop discipline simply because the apprentices are university students. Any attempt to evade the disciplinary conditions which have through the ages made strong men, while it may be an advance on the old four-year system, will not meet the expectations of its sponsors.

These thoughts are born of the questions so frequently asked us by college teachers not situated in industrial centers and by others who are in factory communities, but who have a vague fear that somehow the standard of their scholastic work, their dignity and their independence will be jeopardized by contact with the wicked world.

Opposition to Physical Work

It is astonishing how much opposition there is to that part of our system which requires a student to do the hard physical work of laborers and mechanics. Engineering professors, particularly, and in some cases practising graduates from four-year courses, seem to feel strongly that the high plane upon which the engineering profession is supposed to be, is in danger of being let down a peg, if embryo engineers begin their careers as apprentices. I have never been able to get a crystallized, logical statement of these objections. Personally, I believe that a goodly amount of physical work in contact with those whose lot it is to labor should be required of every young man in his formative years, no matter what his position in life is, or is to be. Especially should it be required of future engineers. Strong men have always grown stronger and better through this contact and competition, and the weaker ones find their levels more quickly than in any other way.

Why an engineering college should not adopt Nature's rigorous methods of finding leaders is not evident, and if engineering education should be for any particular purpose, it should certainly be for the training of leaders in production and construction. Surely, a youth approaching manhood who does not feel within him the craving to measure his strength of body and mind with those who do the day's work lacks certain qualities necessary for leadership; and should not, therefore, get the training intended for leadership. And if he does have the craving, let him satisfy it; let him grow naturally, guide his growth, and supplement it with proper intellectual instruction.

In our opinion, the man who has not the will and willingness to do physical labor in the practical engineering world is not a promising candidate for the engineering school; nor do we believe that imitation work in imitation shops should be offered to the students as an equally good, but easier and more dignified substitute for the character-building, man-making real work of real shops. Indeed, there is a sort of academic snobbishness, most unwholesome for the students, and most undemocratic in its essence, which looks askance at all knowledge that does not come by the book, and which feels that between the practical and the intellectual there is a great gulf fixed.

The Business of Training Engineers

Now I assume that we are in the business of training men for the practice of engineering; and I further take it that the practice of engineering means the economical use of the forces and resources of nature for the benefit of mankind. The day has come when we must place honest emphasis on the word "economical;" we must also remember that mankind means all men, the majority of whom are those who produce and construct in using the resources of nature. We are, in fact, servants of each other, and in this mutual but complex interdependence of production, we have for some time been leading surely to a crisis, which grows more acute as the nation becomes more industrial, and which will necessitate the solution of two problems: First, the elimination of waste in production, and secondly, the scientific use of labor to the end that it may be most efficient, best rewarded and properly conserved. These are matters not for the lawyer and politician, but for the engineer. That day is passing when the magnificent waste of men and materials can be an ignored consequence of achievement.

The integration of a multitude of shop errors between the limits of January 1 and December 31 is now as much an engineering problem as the most delicate deduction in calculus. The training necessary to find all the factors which enter into this integral equation is just as much a part of engineering education as is mathematics. A working knowledge of the toxins of fatigue is as important, to say the least, as an ability to discover and eliminate the impurities in castings. To conserve the years of labor is as much a part of economical engineering as to find a good preservative coating for bridges. A knowledge of the limitations, the weaknesses, the group subleties of men, is as requisite as a similar knowledge of materials.

If we are to have a saving solution of this broad engineering problem of conservation in production, the men who tackle it must be initially aggressive in spirit and keen of mind; they must be deeply versed in science; they must have a thorough and intimate knowledge of men and materials; their instruction in the humanities must give them breadth of vision, and the resultant breadth of tolerance; and they must know the real problem as it is.

The Reflex Action on the University

In joining with producing and constructing concerns to train young men for this type of engineering activity, we anticipated that there would be a reflex action on the engineering college. The reaction was not slow in coming. It was more in the nature of a flareback. My telephone was very busy that first half year: "That cub you sent down here," the voice would say, "thinks this is a university. He won't work." It did not take us long to learn that it was necessary to paint the shop end of the course to aspiring Edisons in broad, black, greasy, sweaty strokes. One after another, young men came to inquire about the work and one after another they would surrender to their mental aversion for early hours and much grime. But there was a fine residue from the sifting, a residue that meant business. Each year our list of applicants has grown and the selection has been more and more rigid; as a result, our losses during the summer tryout decreased as the following table indicates:

LOSSES DURING SUMMER TRIAL PERIOD IN PER CENT.

Year.	
1906	40.9
1907	28.4
1908	13.6
1909	8.1

We also learned that first year, and have had it verified each year since, that the shop will spot a yellow streak in a man before the university even suspects it. An attempt to sneak spoiled work through is never a great success. It is not even a commendable failure, and the rest of the workmen view it with tersely expressed disgust. It requires only a few days for a young man to realize that he must stand squarely on his own merits and that most of the men in overalls about him are a peculiarly keen lot of men worth cultivating. And this is when young Edison begins his combination course in tact and integrity.

We at the college end soon found our work under a scrunity and criticism, with final judgment suspended, and this too from a source which does not hesitate to scrutinize and criticize. We are brought face to face with the failure of a university department as we never are in our four-year courses. A student, let us say, has finished successfully his work in physics; some day he does a fool thing in the shop which indicates that he knows very little about the subject. When you confront him with the fool thing and with the fact that he should have known better because he had been taught the theory governing it, you find his

grasp on the theory to be very feeble. It is not a part of his working organism.

The Co-ordination of Courses

Experiences of this sort caused a serious introspection on the part of our teachers, and a consequent readjustment of our courses and methods. We soon found that much of our trouble resulted from a lack of coördination between courses. After trying various plans to remedy this, we now have a system whereby each course is charted in a circle clockwise by weeks. At the periphery of the circle are the names of the teachers who tie to the particular work of any week. Every teacher gets a copy of every course chart. The instructor in charge of the course is chairman of a committee on that course, the other members being those whose work correlates with his. In this way a number of men may teach a subject which was formerly taught by one man. For example, the professor of metallurgy enters the bridge-design and testing-laboratory courses at appropriate times; the professor of industrial chemistry gives part of the course in cement.

Our experience also taught us that it was necessary to have a separate set of men to coördinate the work of the shop with the work of the university. A department was started to do this, and men were appointed of the grade of assistant professor and with the title of coördinator. The shop coördinator is a college graduate acquainted with shop practice. He spends every morning at the university and every afternoon in the shops. His function is to make a direct weekly coordination of the work of the shop with the theory of the university. One afternoon, for example, he may be at the shops of a local manufacturing company, where he will observe the student apprentices at work. He will know what they are turning out, their speeds, their feeds and cuts, the angle of the tool, how the batch of work is ticketed, how the work is set up, the power drive, everything important in connection with the operation.

The next week these young men will be grouped together with their classmates for two periods in class, when he will explain the functions of the particular articles on which the students were working, in the machine which the local manufacturing company builds. He will take up all questions of speeds, feeds, cuts, accuracy, etc. Figuratively speaking, he will take from the student apprentices the blinders which would restrict their vision except for this explanatory work. The ticketing of the batch of work is gone into, and the system of shop routing is explained. Ultimately all problems of shop organization, shop accounting, cost keeping, shop planning, power transmission, heating, lighting, etc., are discussed during the course.

In conjunction with this, a card system is employed by means of which everything the student does in the shop that exemplifies a theory taught in the university, is called in detail to the attention of the teacher of theory, so that when the student comes to that particular theory, the exemplifications which he has had in his practical work in the shop are called to his attention. It will be seen, then, that out of the student's own experience is drawn much of his course in mechanism, thermodynamics, machine design, strength of materials, shop economics, etc.

This system has been in operation for one year, and is one of the most valuable additions we have made to the scheme. The coördinators have made a careful study of each shop, and are now completing organization charts showing the path which a student can most profitably follow through the shop. In addition to the shop chart, a chart is made for every individual student which indicates how closely this path has been followed, and why there have been deviations, if any. These charts are the result of four years of closely observed experiment on the part of the university and the shops, and have been worked out by conferences between shop coördinators and shop superintendents.

The Scientific Spirit Is Not Killed

Our critics have always felt that the amount of work given would tend to kill the scientific spirit, and to instill a too practical one. A recent occurrence worth mentioning in this connection, was a meeting of all the coöperative students with the faculty to discuss the five-year, 11-month plan of operation. At this meeting the students who have been with us three or four years strongly expressed the hope that the course would be made six years long, 11 months of the year. None of the students wanted a six-year course, nine months of the year.

When the vote was finally taken, it was found that all the men who had had three or four years of the work wanted a six-year course, 11 months of the year, while the younger men were unanimously in favor of a five-year course, 11 months of the year. The reason given for their attitude by the older coöperative students was that they wanted to take up in the university, advanced scientific work of a post-graduate grade, together with certain academic subjects such as psychology and logic, and that they desired also to take a more comprehensive group of technical subjects than is usually given in any engineering course. That is to say, they have become so impressed in the shop with the broader aspects of engineering, that they desire to touch not only the technical subjects of their own courses, but also many of the technical subjects of other engineering courses.

As a result, courses will be arranged so that men, on graduating after 5 years, will be enabled to take one or two additional years if they so desire. This attitude was not surprising to those of the faculty who were watching the development of the coöperative students. A curious, and, I think, entirely unusual situation was developed in the meeting, when nearly every speaker on the students' side solemnly warned the faculty that no measures should be taken which would in any way endanger the high standard of the coöperative course in the university.

Of course, our experience in four years of operation has enabled us to determine in advance that the usual work of the four-year theoretical course could be carried on by coöperative students in five years of half-time work 11 months of the year, even though the standard maintained in the coöperative work is much higher than that of the four-year courses. A student's rating, by the way, is not determined by examination, but by a record of daily efficiency. We have abolished examinations, but pay very close attention in the weekly faculty meetings to the weekly records of our cooperative students. Short written tests are given frequently, and without advance notice. A certain pace is set and if the student cannot or will not maintain it, he is dropped from the course.

Teaching How to Tackle a Problem

We are more and more convinced that the best thing a university can teach an engineering student, is how to tackle a problem, and to this end most of our summer work is devised. All of the summer work in the university is to be constructive, following the analytical work of the previous year's theory. For example, the student's first problem will be something like this: "There is a barrel of rock salt; you are supposed to have a certain knowledge of theoretical chemistry after your year's work. Here is the laboratory; here, also are the necessary industrial implements; over there is the library. Now go and make four pounds of table salt. At five o'clock each day let us have a written report on what you have accomplished."

Following this and other simple problems, the work becomes more complex, leading into boiler compounds and metallurgy. The student will be compelled to rely almost entirely on his own resources, except for critical suggestions following errors, and by the time he has reached his third summer, it is hoped that he will be able to use the laboratory, the library and his theoretical knowledge to make a logical and effective attack on a new piece of constructive work. In his last year he will have several problems which will involve theoretical considera-

tions that he has never met, except, perhaps, in the fundamentals of physics.

Many additional changes in curriculum and method are in process of development, looking to a more rigorous mental and physical training of our young men for work in production and construction. And though a few of our students upon graduation will become teachers of future coöperative students, and a few more, temperamentally fitted for work in pure science, will join the freemasonry of those who explore beyond the ranges of the known, the majority will continue in the more prosaic business of helping to do the world's work. And these will bring to their tasks a working knowledge of the many-sided life of the shop and field, coupled with an ability to apply to it the rapidly increasing fund of material which the pure scientists uncover, to the end that the yield may be greater and the spirit of the labor brighter. And this, I take it, is engineering.

Welding Locomotive Frames

By J. S. Pearce*

The subject of locomotive frame failures and welding with oil has been given considerable prominence of late. Some good results have been recorded, but still some are skeptical of the desirability of this method, it being such a departure from past practice. I feel convinced that anyone who takes hold of this method will soon prove that the results are as durable as the old method on the blacksmith forge and the job can be done with a great saving of labor, time and expense, providing the break is in such a position that the oil heater can be operated.

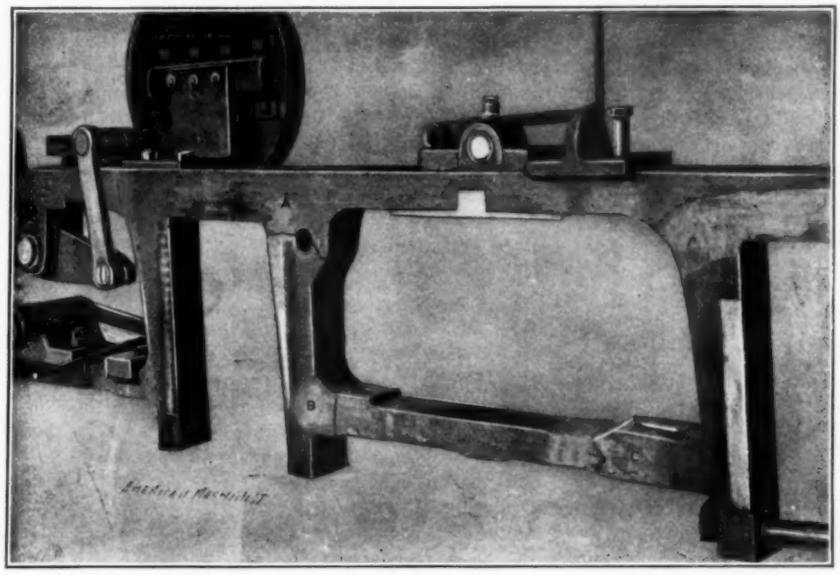

FIG. 1. BROKEN SIDE FRAME BEFORE WELDING

In Fig. 1 is shown a locomotive side frame that we welded in this way. It belongs to a 78-ton Consolidated engine, and the break at *A* was through the transmission-pin hole. The section through the pedestal at this point measures 4½x 8 inches and the pin hole was 2 inches in diameter. The section through the break at *C*, on the bottom rail, was 4½ x4⅜ inches, and the break at *C* was 3x 4½ inches. The frame after welding is shown in Fig. 2, which shows how perfectly they were made. The transmission-pin hole was plugged and welded up and afterward drilled out. This gave an opportunity to examine the weld clear through the section of the frame at this point, and it proved to be completely welded clear through the center. The engine, with this frame in it, has now been running for 7 months, which proves the durability of these welds.

In preparing the frame for welding, we do no chipping or drilling, but merely spread the frame and insert a piece of iron that projects out from the sides of the frame ½ inch. The thickness of the piece of metal depends upon the weld made. Usually ⅜- or ½-inch metal is used. In this case no special effort was made to reduce the time on the job or the cost of the operation, the aim merely being to make a good permanent job. The cost of welding this frame, however, was $10.81.

The simplicity of the oil methods must appeal to everyone, as no special appliance is required beyond the burner and some firebrick and fireclay, these being ordinary shop accessories. Therefore, a roundhouse can handle such repairs without having to send the engines to terminals, and avoids the necessity of taking the frame down to be sent to the smith's shop. We have used this method quite extensively, and so far have not had a failure.

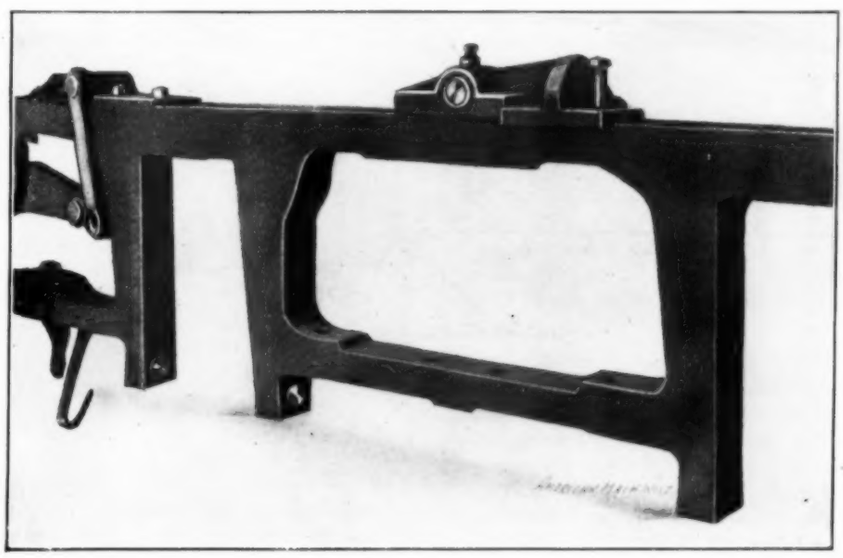

FIG. 2. SIDE FRAME AFTER WELDING

*Master mechanic, Norfolk & Western Railroad shops, Portsmouth, Ohio.

FIG. 3. APPARATUS USED FOR FUEL OIL WELDING

In Fig. 3 is shown the complete equipment that is used in making these welds. In addition to the burners, pipe and hand tools will be seen two coil heaters. The air passes through these before entering the burner and a light wood fire is kept inside of the coil to heat the air and dry out any moisture. This heating greatly reduces the time required to give the proper heat and insures against failure.

Using the Micrometer

It is sometimes queer the amount of trouble people will go to to avoid a little study. A recent development in a middle western shop is an example of this.

One of the foremen had been setting the micrometers for various workmen who did not understand its "mysteries" for several years. It now develops that he did not understand the use of the tool as well as some of his men, and had been obtaining his setting from a set of standard parts which he kept handy. To some of us it would seem inconceivable that such condition could exist for any length of time.

This is a true story nevertheless. Five minutes' earnest study would have revealed the principles of this tool to the man and yet he avoided it, and bluffed. Of course, some will say that this could not have happened east of New York, as in that country the boys become accustomed to the use of the micrometer early in life, their first use being as teething rings.

Diamond Tool and Holder

By J. Arthur Phillips

The sketch illustrates a diamond tool and holder I made for use in the universal grinding machine when engaged in light-tool and gage work; a good sharp corner on a diamond is then a very desirable thing, and this tool seems to just fill the book.

The tool consists of a diamond set in a piece of copper or steel, threaded at end to screw tightly into a ball that has been softened, drilled, tapped and rehardened.

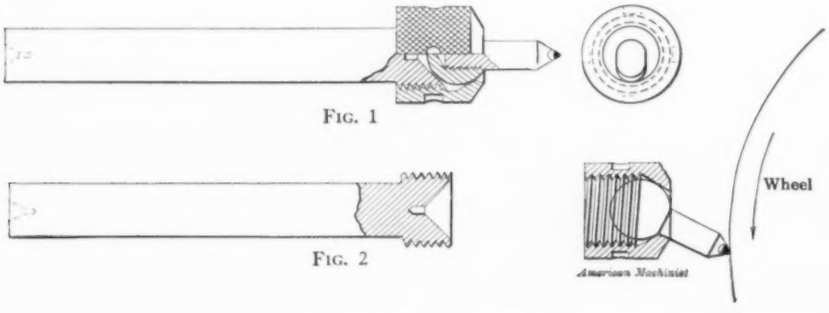

FIG. 1

FIG. 2

DIAMOND TOOL AND HOLDER

The holder is in two parts; the shank and the nut, or cap.

Fig. 1 is the assembled tool, part in section.

Fig. 2 is a section of shank and nut with tool inclined in the direction the wheel is revolving.

The shank is a length of steel, reduced in diameter to within a short distance of the end which is threaded. This end is countersunk with a conical cutter of 90 degrees, after being drilled with a small drill to relieve the point of the cutter.

The nut, or cap is threaded to suit the shank. The thread must be so chosen that the core diameter will admit the nut passing easily over the ball, and the included angle of the faces that tighten on the ball is 60 degrees. The front of the nut is cut away at one point to permit setting the tool at an angle with the shank.

In use, the tool with newly set, sharp-pointed diamond, is set straight in the shank; the point then contacts with the wheel. When the point is worn off and a flat is formed, the sharp edges of the flat are brought into operation on the wheel by slacking the nut, and setting the tool at an angle with the shank by locating in the part of the nut cut away; then, as the edge is worn away, the tool is turned around in the nut, keeping the same angle with relation to the shank until all the edge of the flat is worn off, thus automatically producing a point again, when the tool is set straight to bring the new point into play, and the cycle of operations repeated.

When using with the tool at an incline, it is wise to see that the shank is set in the machine in such a manner that the tool points downward as in the sketch, the wheel has then no tendency to slacken the nut by vibration and drag the diamond down to its destruction.

A paper on "copper-clad steel," presented at the convention of the American Society for Testing Materials, made clear that this steel is made by casing a steel bar in copper. This compound bar is then rolled and drawn down, the areas of the two materials being reduced proportionally so that if the original cross-section of the bar comprises one-third copper and two-thirds steel, the wire made from it will have a section of one-third copper and two-thirds steel. There is no definite surface of junction between the two metals, but, on the contrary, an alloy is formed which has been found to possess unusual resistance to corrosion. The wire made in this way has high conductivity and high strength.

Features of the Beech Grove Shop

Editorial Correspondence

Some of the methods used by the Big Four Railroad in their Beech Grove Shop. They include: Handling piston rods and crossheads, planing trailer boxes, test gages. Piece-price reference, driving box wedges and making twisted drills.

In handling the fitting of crossheads to piston rods in the Beech Grove shops of the Big Four Railroad, every convenience is afforded the men in order to facilitate the work. The planing is done on a planer at the end of the row of pistons, and the crossheads are handled from the planer table to their respective rods by small trolley hoists. The planking which supports these is simply stood on edge and notched at the proper places to hold the rod. While there is nothing startling in this arrangement, it shows a very simple method of handling this work easily and rapidly.

Fig. 2 shows a storage rack for piston rods and heads, which allows them to be piled three tiers high, and by placing them in alternate position as shown, a comparatively large number of crossheads can be stored in a small space.

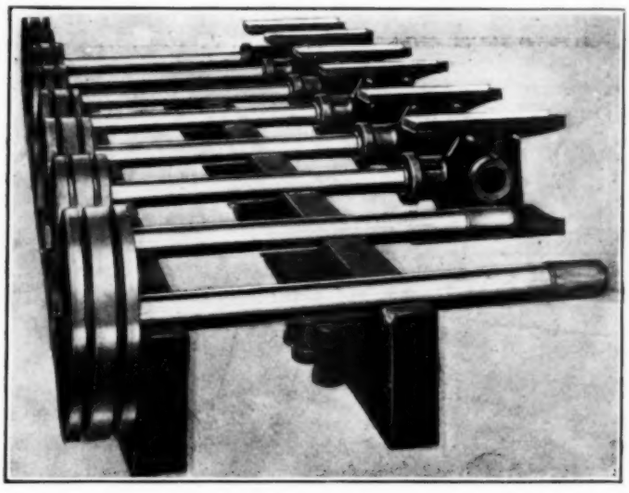

FIG. 1. TILTING CROSSHEADS TO PISTON RODS

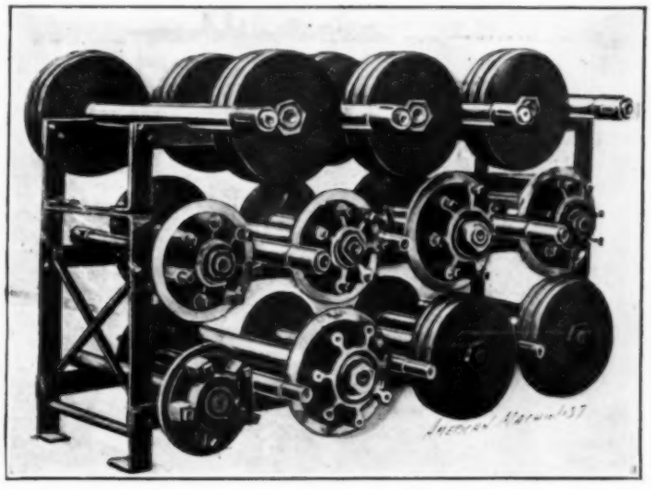

FIG. 2. A COMPACT STORAGE RACK

PLANING TRAILER TRUCK BOXES

Fig. 3 shows about the largest form planing we have ever seen, even in soft metal. The work is a trailer truck box for an Atlantic or Pacfic type locomotive which is being planed on a traversing-head shaper, with the large forming tool shown. This forming tool is simply a steel disk of the same diameter as the axle on which the box is to run, and when it becomes dull in one portion, it is simply necessary to turn it until a fresh edge is presented. Considering the length of the cutting edge, and the machine on which this was being done, there is comparatively little chatter. A good idea of the chips removed can be had from those which are in front of the box.

A GAGE TESTER

Fig. 4 shows the gage-testing device which was built by W. R. Beck, the air-brake foreman. This is used for testing steam and air gages in the locomotive department, and also gas gages used for the Pintsch Lighting System on passenger cars. The test gage at the left was purchased from the Crosby Company and registers pounds to the square inch on the outer graduation. The inside graduations were laid off by Mr. Beck, to show the number of atmospheres, so that readings can be had either in pounds or in multiples of 14.7 pounds. The pointer indicating atmospheres is attached to the main hand and shows through the diamond-shaped hole near the end.

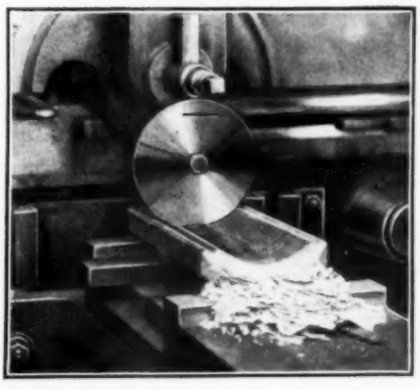

FIG. 3. SHAPING TRAILING TRUCK BRASSES

Pressure is applied by the handle operating the screw plunger in the center, and three gage hand pullers are shown lying on the table.

A HANDY REFERENCE LIST

Fig. 5 shows a form of reference list that is convenient for the men. It consists primarily of an A-shaped frame made of piping, which is fastened to any convenient post. The apex is flattened and drilled for a supporting rod or spindle. This spindle carries the core or roller on which the various leads indicated are mounted, each lead being mounted in turn on a separate wire and consisting of a sheet of galvanized iron. These leaves have turned-over edges at both top and bottom and hold sheets containing any information which it is desirable for the men to have convenient for immediate reference. They contain prices on all the various jobs so that there can never be any question as to the rate of any piece which happens to be going through the job. Any desired information, such as standard tables, can also be made easily accessible in this way.

DRIVING BOX WEDGES

Fig. 6 shows the method of planing driving-box wedges. They are bolted in string to the central support or locating piece *A*, the inthrust of the cutting tool being taken by the crossbar *B*, at the end of the planer table. This enables eight shoes to be planed at one setting by the use of two tools, as shown.

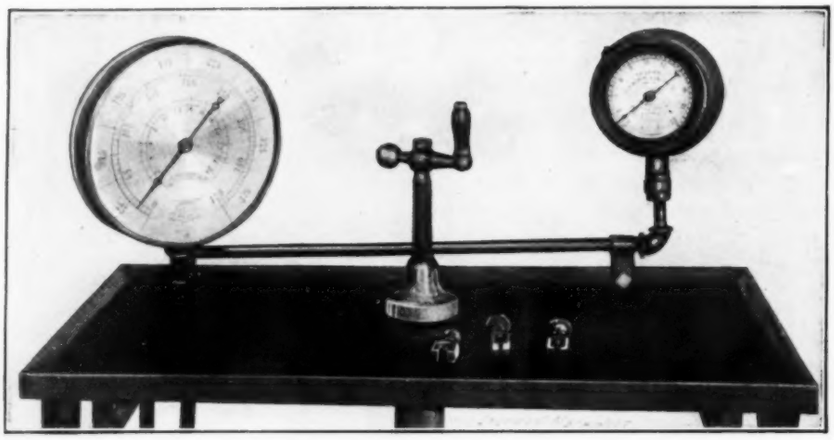

FIG. 4. TESTING STAND FOR STEAM, AIR AND GAS GAGES

MAKING TWISTED DRILLS

Fig. 7 shows a little device in use for making twisted drills from flat high-speed stocks. The end which is to form the shank of the drill is clamped in the holder at the right-hand end and the other end inserted in the slotted end of the stud, which projects from the worm wheel at the left. When the heated piece of high-speed steel has been put in place it is only necessary to turn the handle connected with the worm and the desired twist is easily and quickly obtained. This has proved quite successful in this shop.

COMFORT STATIONS

An interesting constructional feature is the toilet facilities which are more frequent than usually found. Fig. 8 shows their construction very clearly. They are located beside one of the supporting columns, and the screening wall consists of a framework of piping filled in by slabs of concrete, which were poured in position. The curvature of the pipe, in addition to the tendency of the concrete to adhere to the iron, holds these firmly in place. They are very light and particularly well ventilated, as can readily be seen.

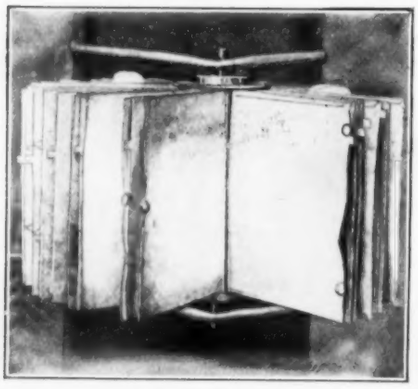

FIG. 5. PIECE RATE FOLDER

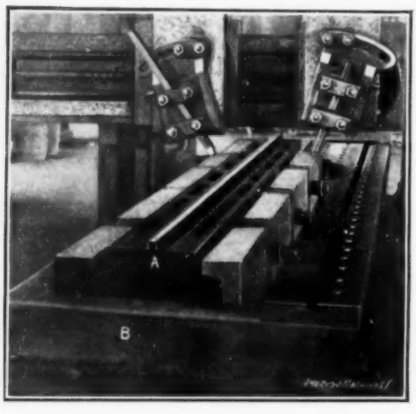

FIG. 6. PLANING DRIVING-BOX SHOES

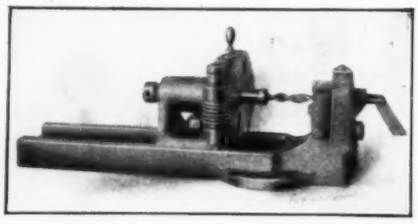

FIG. 7. MAKING TWISTED DRILLS

FIG. 8. TOILET FACILITIES AT BEECH GROVE SUOP

The wash stand on the outside of the wall is of enameled iron and the whole thing is neat and easily accessible.

Inserted Teeth Gear Repairs

BY J. F. HOBART

Think twice, and then think a couple of times more before repairing an important gear with inserted teeth. Take, for instance, one of the gears which drive the cutter in a large milling machine. Two adjacent teeth were broken and the office authority insisted upon the insertion of a couple of dovetailed teeth. Objections were made by both the shop superintendent and the foreman, but they were overruled by the office and the teeth were dovetailed into the rim of the gear.

The inevitable happened. The first heavy strain to which the gear was subjected, caused the inserted teeth to become loose and then but a very few revolutions were required to complete the work and a dozen teeth stripped from the gear and, becoming entangled in the other gear, it was also ruined and the spindle bent out of truth so that it had to be sent to the maker for repairs. When a gear strips one tooth, it may answer for the time being to insert a tooth, preferably by drilling in a couple of wire stubs and then dressing them to tooth shape. But when two adjacent teeth have been lost, never even think of inserting teeth or studs. Just get next to the long-distance 'phone and start a new gear coming at once.

There are certain places and times when it may pay to repair gears by inserting teeth as described above, but the milling machine is no place at any time for such work. If a couple of teeth get knocked out of one of the change gears belonging to a screw-cutting lathe, then it may possibly pay, under certain conditions, to drill in a couple of teeth for such gears usually have very light duty to perform and the inserted teeth will probably hold. But, even then, take immediate steps to procure new gears in place of the broken ones, for a gear with an inserted tooth is a delusion and a snare, to be avoided whenever possible, and to be thrown out as soon as possible.

It is always best to make sure. Foresight is better than hindsight, but even this may be carried to extreme, as is illustrated by a conversation heard some time ago in a large machine shop.

"Bill says that plug you sent down will not do. He says he is working on 2-inch bores and that plug is 3 inches and that it won't go in. He says he is sure it won't go in, 'cause he tried it and knows what he is talking about."

Machining Bevel Pinion Blanks

By C. L. Goodrich*

How the Pratt & Whitney 2 x 26 inch turret lathe is equipped for accurately turning and facing steel bevel pinions with single pointed cutting tools.

The bevel surfaces are machined to the correct angle by means of an angular turning fixture carried by the turret.

*Department foreman, Pratt & Whitney Company.

An interesting example of the adaptability of the turret lathe is found in the accompanying illustrations, which show one of the Pratt & Whitney 2x26-inch turret lathes, especially equipped with tools for turning and facing bevel-pinion blanks. The cutting tools utilized for the work are ordinary single-point engine-lathe tools, and are held in traversing slides which are adjustable for work of varying angles and diameters.

Advantages of the Equipment

For machining the angular faces of bevel pinions when made from soft-steel broad, flat cutters have been used extensively. The equipment illustrated, as stated previously, uses single-point cutters and thus is not only suitable for machining soft material, but is particularly satisfactory when hard steel forgings or castings are to be turned.

The machine equipped for the work is shown in Fig. 1. Previous to the operations performed in this machine, the hole in the pinion blank should be reamed, the end of the hub finished and keyway splined. The blank is then held on an arbor and the front end faced by tools held in the turret, after which the three angular faces of the pinion are simultaneously machined by tools mounted on the cross slide and turret.

Arbors for Holding the Work

Two types of workholding arbors are shown, one being used for holding pinions having cylindrical holes, and one for pinions with conical holes. The expanding-pin type shown in Fig. 2 is utilized where the pinion being machined has a cylindrical hole.

The construction of this arbor may be better understood from the line drawing, Fig. 3, in which the method of expanding the three pins by drawing back a rod, having three angular slots is shown. The drawing back of the rod is accomplished by screwing the nut shown in Fig. 2 upon the rod.

It should be noted that when the blank is secured to the arbor by expanding the

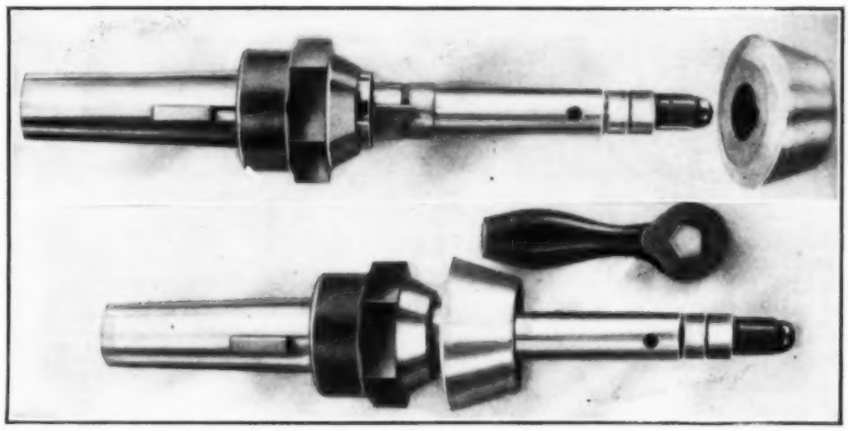

Fig. 2. Arbor for Holding Pinion Blanks with Cylindrical Bore

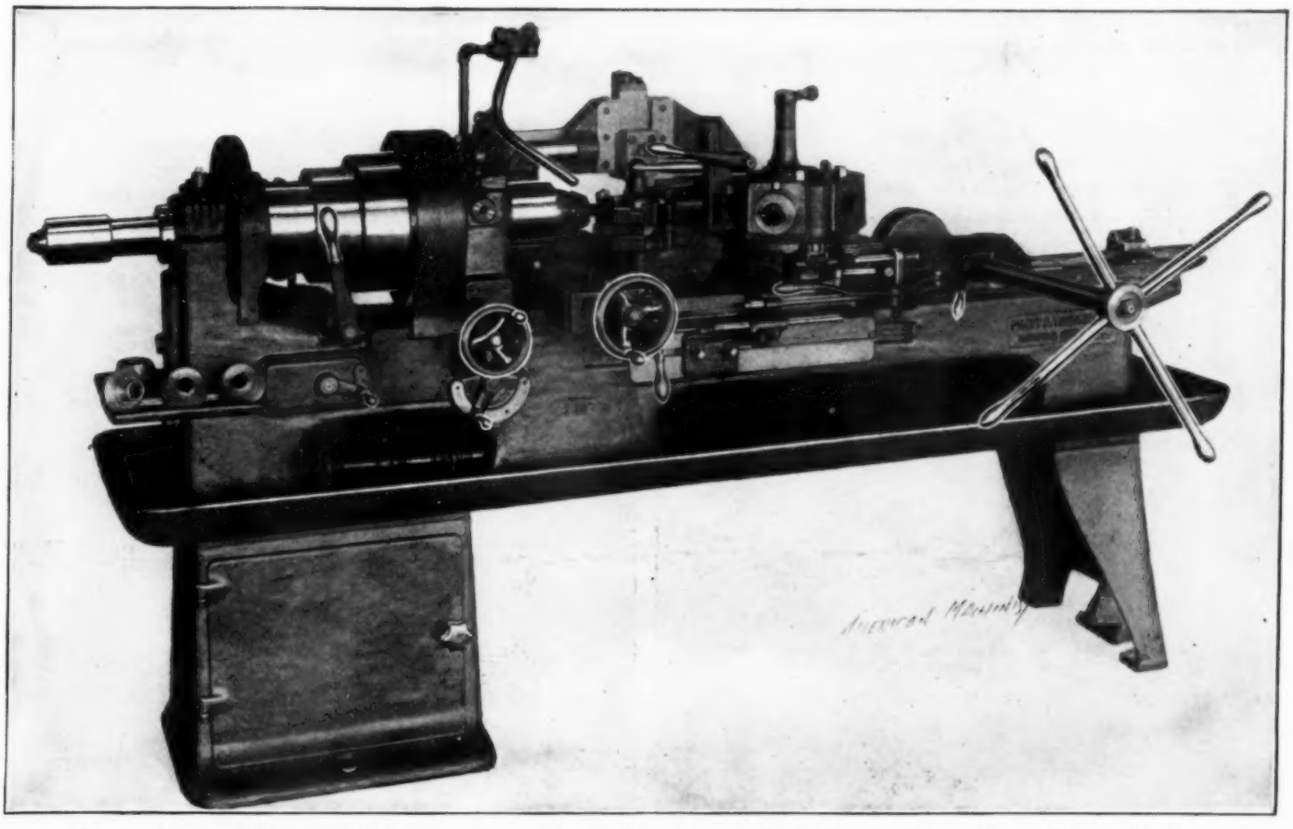

Fig. 1. Pratt & Whitney 2x26-inch Turret Lathe Equipped for Turning and Facing Steel Bevel Pinions

pins, the combination of work and arbor is substantially as rigid as though they were one member; and further, due to the driving key which enters the keyway in the pinion there is no possibility of slippage.

The arbor as shown is provided with a guide or stem, which enters supporting bushings in each of the turret tools and thus makes possible the taking of heavy chips without the least indication of spring or chatter.

Holding Pinions with Taper Bore

In Fig. 4 is illustrated an arbor for holding pinions having conical holes. Fig. 5 shows the internal constructions more clearly. Attention is called to the

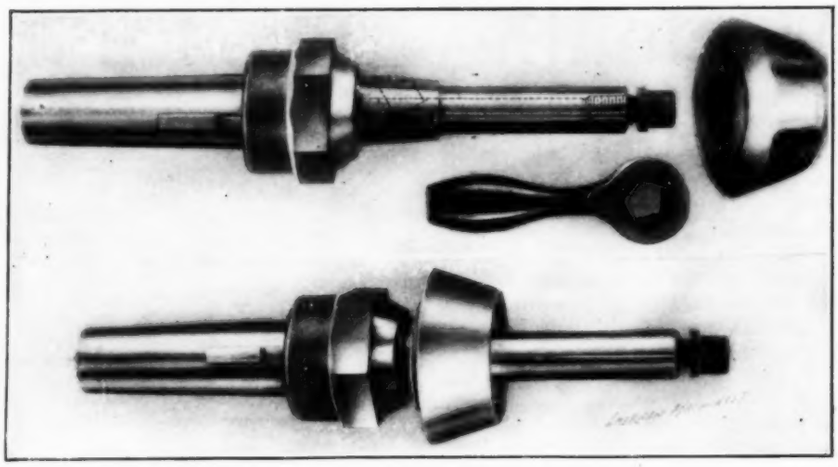

Fig. 4. Arbor for Holding Pinion Blanks with Conical Bore

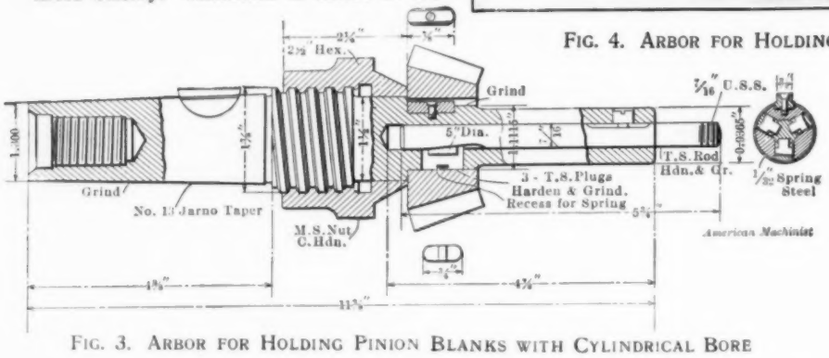

Fig. 3. Arbor for Holding Pinion Blanks with Cylindrical Bore

expanding pin, which operates at such an angle as to draw the blank into the arbor more firmly than when located by hand; and to the checking on the end of the expanding pin, which gives a grip so as to retain the work firmly on the arbor.

The conical arbor has a key entering the keyway of the pinion and also a guide stem as described in connection with the arbor for cylindrical work.

Main Attachments

Figs. 6 and 7 clearly show the large fixtures on the machine. The swivel cross slide is used for facing the two angular sides of the pinion while the special turret fixture shown is utilized for turning the outside angular face of the pinion.

Both cross slide and turret slide may be operated by either hand or power, and each has independent adjustable devices for automatically releasing or "knocking off" the power feed. The rate of feed may be quickly changed without stopping the head spindle.

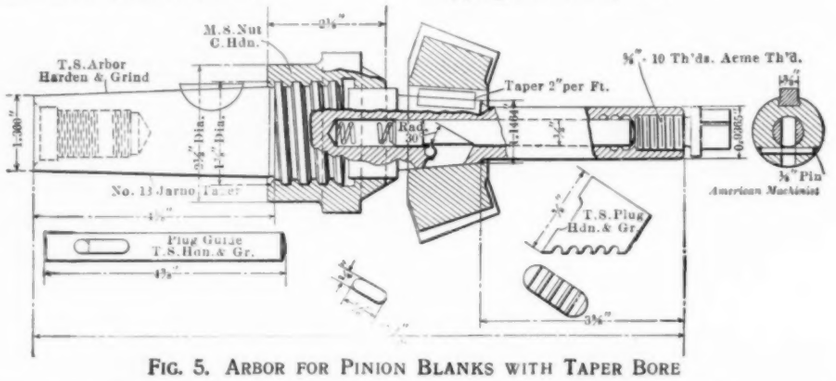

Fig. 5. Arbor for Pinion Blanks with Taper Bore

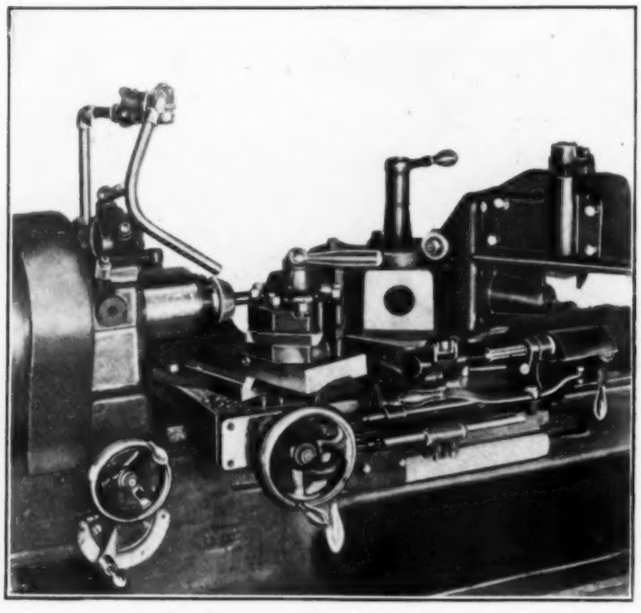

Fig. 6

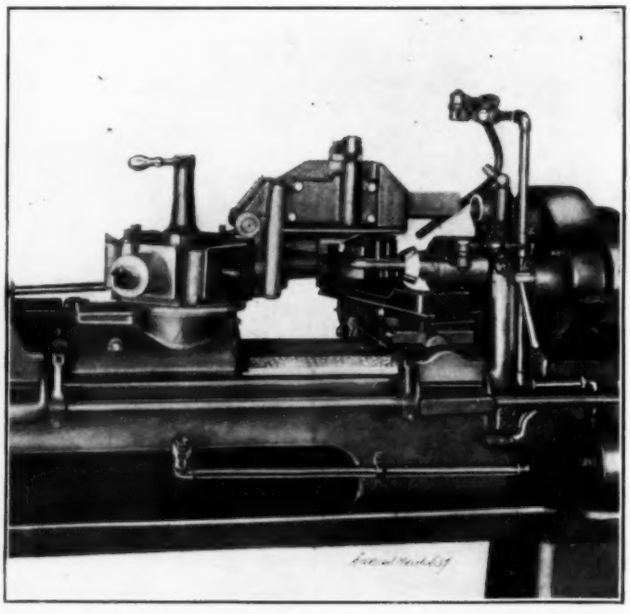

Fig. 7

The Swiveling Cross Slide and Angular Turning Attachment

Construction of Swivel Cross Slide

The swivel cross slide is adjustable to suit the various angles required and may be securely clamped and operated at any angle up to 45 degrees.

It is provided with a swivel tool-carrying block, so as to permit the taking of roughing and finishing chips. The tool-carrying block has two sets of straddle tools, and these may be adjusted to various widths, according to requirements. The block may be quickly clamped in working position by the binder handle shown, after indexing from roughing to finishing cut, or *vice versa*. It is only necessary to take two cuts on blanks when the amount of stock to remove is excessive, or when very hard material is being cut.

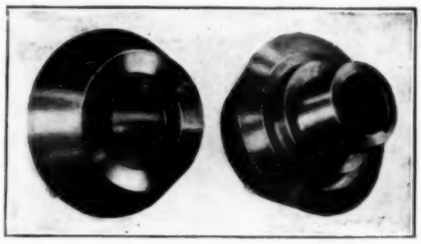

FIG. 8. TWO MACHINED PINION BLANKS

Angular Turning Fixture

The turret angular turning fixture is rigidly clamped to one of the dovetailed faces of the turret while the outer end of the fixture is well supported by the overhanging arm which, when the fixture is in operation, enters a supporting bracket on the head of the machine. The turning tool is held in a vertically moving slide, which is controlled by a sliding-taper bar.

The Work Produced, Drive, Etc.

The pinions shown by Figs. 8, 9 and 10 are machined on the surfaces indicated at the rate noted on the drawings. These pinions are members of a differential gear box for automobiles and are of hard steel.

The machine is provided with three-speed countershaft, which in connection with the double friction-head gearing and open belt, gives 27 spindle speeds. Provision is made for generous lubrication of the tools, and it is remarkable how long the cutting edges stand up without regrinding.

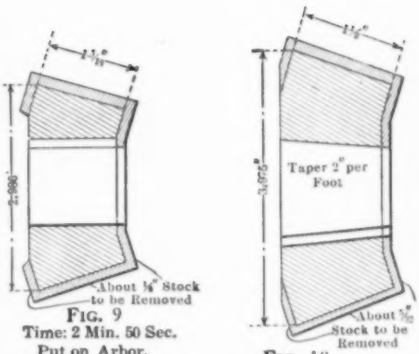

FIG. 9
Time: 2 Min. 50 Sec.
Put on Arbor,
Machined as shown
and removed from Arbor.
American Machinist

FIG. 10
Time: 3 Min. 50 Sec.
Put on Arbor,
Machined as shown
and removed from Arbor.

DETAILS OF TWO BEVEL BLANKS

Discussion of Planer Feeds

By E. H. Fish

The split-ring friction is not as great a saver of power as is sometimes imagined. Design of a positive ratchet feed for severe service.

When I was building planers our most serious trouble was with the feed, or friction as we called it.

Years ago anyone and everyone used the cannon-ball feed. This consisted of a 16-pound round shot hung on the shipper rocker so that when the table came to the end of its stroke and hit the rocker it (the ball) would fall over with a bang, sometimes onto the operator's knee and sometimes on the stop. The feed screw was connected to the rocker by a series of links and bell cranks so that this falling of the rocker and its cannon ball would actuate the feed. The trouble with this was its lack of power. It would not carry two heads and hardly one, or more than 1/16-inch feed.

The next thing was a cone friction feed. In this there was placed a conical cast-iron head on the next shaft to the pulleys. This shaft was carried out beyond the housing for that purpose. On the outside of this conical head was another cast-iron plate with a tee-slot across the face. This plate was fitted to run on the conical pieces with a rawhide collar between the two. A bolt connected the two at the center so that the tension was sufficient to make the two turn together until the outer plate struck one of two dog pins in the side of the housing to limit its throw. This plate turned with the shaft at each end of each stroke but during all the rest of the time it was a dead drag on the planer of an amount determined by how hard the operator kept the conical friction surfaces screwed together. This was usually determined by the fact that if they were tightened up any more the rawhide would smoke, consequently there was the maximum possible waste of power at all times.

The Split Ring Friction

The next move was to use the split-ring friction shown in diagram in Fig. 1. The hub G is keyed to the second shaft (counting from the pulley shaft). The ring H is split at K and drawn together by a through bolt at $B\,B$ with a heavy spring on it to regulate the tension and to allow the ring H to be slightly spread apart by the lever M. Lever M is secured from falling out of the split K by means not shown, but easily supplied. The lever M is limited in its travel by dog pins $L\,L$ in the side of the housing.

It is obvious that as the disk G is rotated first one way and then the other on alternate strokes of the planer, ring H will go with it under the friction caused by bolt B so far as stops $L\,L$ allow it, but that when M strikes against L it will press against it and acting as a lever tend to open ring H. It is also apparent that the friction between G and H cannot be lessened too much because then there would be nothing to hold M against the stop. This form of feed is still in very general use and gives good satisfaction, almost as good as the dead steady friction that preceded it. We were at first hypnotized by the claims of our competitors and thought that we had struck the cure for all our ill[s] but we thought to reason the thing out and be able to tell our customers just how much power we really could save.

We laid out the forces acting on the lever M as shown in Fig. 2, where E is the pressure of dog pin L and D and C are respectively the pressures on M from the two sides of the ring H.

From Fig. 2 we see that

$$E + C = D \qquad (1)$$

$$Er = Da \qquad (2)$$

$$Cr = D\,(r - a) \qquad (3)$$

In Fig. 1 we drew the forces acting on H; D and C are the same forces as in Fig. 2, but they, of course, act in the opposite direction. And $B\,B$ are the forces due to the spring bolt drawing the sides of H together. F is the frictional force between ring H and hub G, f is the coefficient of friction; r is the radius of hub G and also the distance from the outside of the hub to the pin L; a is the depth of the split in ring H.

Taking moments around the center of the shaft we have

$$Fr + Cr = D\,(r + a) + 2Er \qquad (4)$$

Also

$$F = 2f\,(B - D) \qquad (5)$$

or

$$F = 2f\,(B - [E + C])$$

since the friction is due to the hoop ten-

sion of ring H on G. Substituting in (4) the values of Er and Cr from 2 and 3 we have

$$Fr + Dr - Da = Dr + Da + 2Da$$

or

$$D = \frac{Fr}{4a}. \quad (6)$$

Putting this value of D into (5) we get

$$F = 2f\left(B - \frac{Fr}{4a}\right) = \frac{8afB}{4a + 2fr}. \quad (7)$$

If there had not been any lever M equation (5) would have read $F' = 2fB$ (8), consequently the saving due to using this device is only that due to the difference between F of equation (7) and F' of equation (8). The bolt tension B can, of course, be made anything within reason.

To see how much of a figure this cuts let us take an actual case. Here is a friction where $r = 4$ inches, $a = 1$ inch and we will assume $f = 0.1$ which is higher than usual, and on the side which will favor the split ring.

Then

$$F = \frac{8 \times 1 \times \frac{1}{10} \times B}{4 + 2 \times \frac{1}{10} \times 4} = \frac{B}{6}$$

and

$$F' = 2 \times \frac{1}{10} \times B = \frac{B}{5}$$

giving a difference of $\frac{B}{30}$ only, as the saving in friction. This is evidently not enough to pay for the added complication.

The length of M which we took as

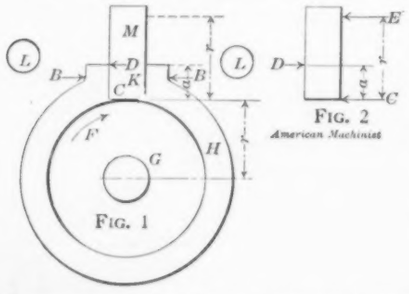

FIG. 1

FIG. 2

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DIAGRAMS OF SPLIT RING FRICTION FEED

equal to r might, of course, be made greater but its only effect would be to reduce the pressure on pins $L\,L$. It would not improve the working or efficiency of the mechanism. Reducing a increased the efficiency. If a is ¼ inch which is about the limit for practical work, then the saving is 1/11 of B, which is still some ways from the claims of many manufacturers.

THE POSITIVE RATCHET FEED

More than this, the friction necessary to feed a 72-inch four-head planer with all gibs set up snug, and a feed of an inch or so is not to be handled by a friction feed of any ordinary size. We were, therefore, forced to get up a positive ratchet feed. All there is to a ratchet feed is a small starting friction whose only duty is to throw a ratchet into operation and a stop pin which will surely throw the ratchet out before it stops the feed plate. Possibly the simplest one of all is shown in Fig. 3, where N is a ratchet keyed to the shaft; O is a light friction ring, preferably leather lined, which turns on a hub of the ratchet and has a projecting fork bearing on either side of pin P. Pin P is a part of pawl Q, which bears in turn on a substantial pin R in the back of the friction plate S. At $T\,T$ are the two stop pins on the housing of the planer. If we suppose the shaft turning in the direction of the arrow, we will see the friction ring O carried in that direction, which throws end U of the pawl into mesh with the ratchet. There is no further movement of the friction ring on the ratchet, but the ratchet, friction ring, pawl and plate turn together until pin T comes in contact with and presses down pawl Q, releasing U from contact with the ratchet.

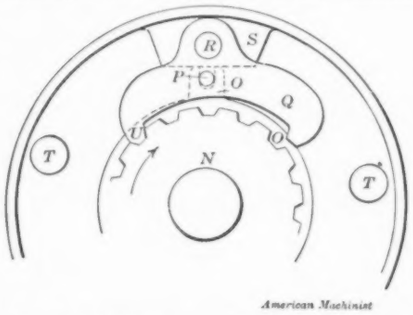

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FIG. 3. DIAGRAM OF POSITIVE RATCHET FEED

The momentum of the parts carries plate S around until T stops it positively by contact with a projection on S. The frictional contact of O and N should be adjustable by a bolt in some way, so that it can be set tight enough to keep S from rebounding away from the pin after having once been stopped.

The two sides of pawl Q should be of different lengths to allow for the different momentum of the parts on the two strokes. The proper ratio can only be found by experiment and is not necessarily very exact. If this device is designed right, it is very satisfactory. By being designed right, I mean that after being designed so it looks about right to be made of cast iron, it should be made all steel. The momentum of the moving parts is such as to put a tremendous strain on all of it except the friction ring, so lightness and strength are both necessary. Being positive, it should be protected by a safety pin or a pair of easily replaceable gears, or in some way so that carelessness of the operator in letting the heads run together will not reflect on the feed works.

TWO FORMS OF PLANER HEAD

We have also had quite a lot of discussion as to the proper form of planer head, whether Fig. 4, where the tool slide carries the down-feed screw, or Fig. 5, where the swivel block carries it, is the best. Both these figures show the tool slides in the same relative positions.

Both are designed so that the bottom of the clapper box can be raised a distance a higher than drawn, and run down the same distance b lower, so that a fair comparison may be made.

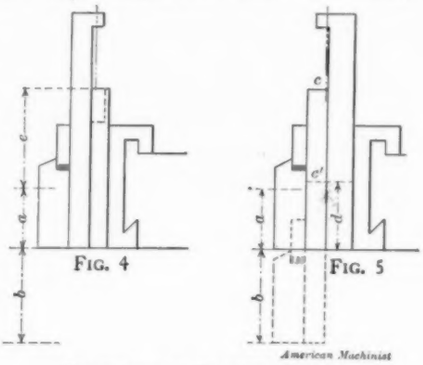

FIG. 4 FIG. 5

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DIAGRAMS OF PLANER HEADS

It will be noted that when both are at the top of their run, Fig. 4 has a bearing length between slide and swivel equal to e. When Fig. 4 is clear down and standing the greatest leverage of the cutting tool, the slide has full bearing in the swivel except for the trifle that the top of the slide can drop into the swivel and allow the feed crank to turn. Some of this is occasionally thrown away by designers in the attempt to form the top of the slide in alleged shapely curves.

In Fig. 5, on the other hand, when run to its lowest point the slide has only the remaining bearing distance d to withstand the increased leverage of the tool. Consequently, Fig. 5 is slightly stiffer at the top of the stroke when stiffness is less needed and Fig. 4 is much the better at the bottom of the stroke where stiffness is more needed. This should be borne in mind, that nine-tenths of the work of the average planer is done with the tool up close to the head and with the parts in nearly the same relative position as shown in the sketches, in which case no particular difference in the two designs is noticeable.

Fig. 4 permits of the lengthening of the slide and consequent lengthening of the vertical run of the head by simply lengthening the slide and the feed screw. I believe that a third longer slide than usual is desirable on planers of 24-inch and larger sizes. The longer slide will often make it desirable to use the crank on the horizontal rod in the cross rail rather than on the top of the head, which in turn leads me to suggest that a ratchet crank is a very nice thing, particularly when a man is leaning far out over his work. This in turn leads to a suggestion that a ratchet applied to the feed rod and up against the side of the head itself and traveling with the head is a great thing for fine adjustments. This should be a reversible ratchet with a little cam arrangement that will free it from the shaft when the shaft is turned.

More Large Herringbone Gears

Special Correspondence

A set of extremely large herringbone gears cut on a new double gear hobbing machine.

Pinions of chrome steel, with a tensile strength of not less than forty tons.

The wheel is of cast iron with forged-steel rims shrunk and bolted to it, having 398 teeth with 99.8 inches pitch diameter.

The gears are mounted in a rigid bearing instead of the floating type recently developed.

The illustrations show two sets of large herring-bone gears made by the Power Plant Company, of West Drayton, England, on their Wüst double hobbing machine which has a capacity up to 14 feet in diameter, 40-inch face and ¾ diametral pitch in cast steel.

The gears in Fig. 1 are for a heavy rolling-mill drive and transmit 750 brake horsepower, reducing the speed from 3000 to 375 revolutions per minute. These have staggered teeth, the center space being about ½ inch.

The gears shown in Fig. 2 are installed in the steamer "Vespasian," which has just gone into service. The preliminary runs served to polish the teeth only, so that there seems to be no reason why they should not have a long life.

The pinions are made from chrome nickel steel, with a tensile strength guaranteed by the steelmakers not to be less than 40 tons, with an elongation of 8 to 12 per cent. in 4 inches, and with an elastic limit of about 30 tons.

The wheel consists of a cast-iron center with two forged-steel rims shrunk and bolted on, these steel rings also being made of high-class material. The wheel has 398 teeth and is 99.8 inches pitch diameter. The actual working face is 24 inches, the space between the teeth being 12 inches, therefore making the total width 36 inches.

The circular pitch is No. 4 diametral, equivalent to 0.7854 inch.

The inclination of the teeth to the axis of the wheel is 23 degrees; the pressure angle of the teeth being 20 degrees.

Lubrication is effected by an oil jet under a few pounds pressure directed from a slotted pipe on to the lines of engagement. This oil is removed from the bottom of the gear case by a pump, and passes through a cooler before being used again. All bearings are lubricated from the oil-pressure system used for the lubrication of the turbine bearing.

Some interesting results have already been obtained in the trials of the ship, most noticeable among them, the fact that the turbines can be reversed from full speed ahead (70 propeller revolutions per minute) to 60 revolutions per minute astern, within 13 seconds.

The installation has been tested at the maximum speed the high-pressure turbine would admit of, and no difficulties were experienced with the turbine speed increased from 1500 revolutions normal, to about 3000 revolutions maximum.

It is interesting to note that these gears are mounted in a rigid bearing instead having a flexible cradle as in the Melville-McAlpine type of gearing. The comparative results obtained by the two methods will be of interest in many ways.

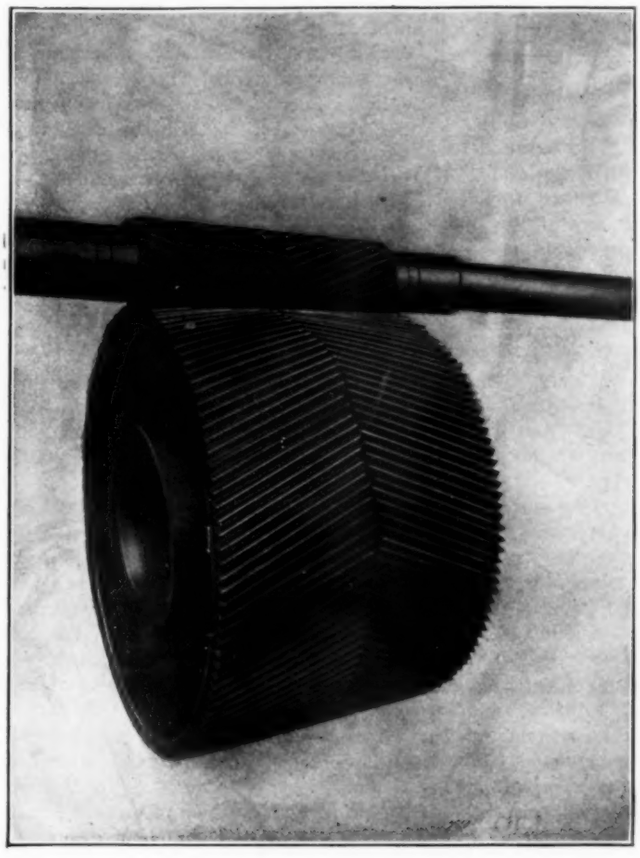

FIG. 1. ROLLING-MILL GEAR TRANSMISSION

FIG. 2. THE GEARS FOR S. S. VESPASIAN

New Method for Base Line Drawings

By H. E. Goldberg *

For detail drawings of very accurate work, such as parts of watches, calculating machines and their like, the base line method of dimensioning is employed, all dimensions reading from rectangular coordinates, or base lines, and thus eliminating the accumulation of errors in machining, due to measuring from a succession of finished surfaces, each in itself subject to a minute error. As all dimensions are from the same bases, this may be improved upon by omitting dimension lines and placing the figures adjacent to the point concerned, resulting in a drawing of unusual clearness.

*Manager, General Calculator Company, Chicago, Ill.

The methods at present used for dimensioning drawings may be divided into two classes, namely, the local-dimension method and the base-line method. In the first method the dimensions are given from a first place to a second, then from the second place to a third, from the third to a fourth, etc. Most drawings are made in this way, and it is also the method ordinarily shown in text books and taught in schools.

In actual practice for very accurate work, the above method is found to be possessed of a vital fault, so much so that it certainly is a most difficult task to use it. This fault is the accumulation of errors. Thus, let a drawing dimensioned in the above manner represent a piece to be machined at various places. Suppose the first place to be machined as a starting point. Suppose in the machining of the second place a small error, not to exceed ± 0.001 inch, be made in the distance between the two places; suppose in machining the next piece a similar error be made, the total error may now be anything between $+0.002$ inch and -0.002 inch. The third place may make the error ± 0.003 inch, the tenth, ± 0.01 inch from the correct point, etc. Should there now be encountered a place which has to be machined accurately in reference to the first place, say, within ± 0.001 inch, then the above dimensions are found insufficient, and other new and extra dimensions, going back to the first place have to be added. Should the piece be complicated and contain a large number of places, some of which must be machined accurately and the rest of which need not be so, the use of the above method of dimensioning gives such a complication of dimension lines and numbers that, as a result, many establishments have completely abandoned its use and employ nothing but the base-line method.

The Base Line Method

In the base-line method of dimensioning drawings, two lines, a horizontal and a vertical, are first laid out. These lines are variously called base lines, reference lines, working lines, starting lines and center lines. Having chosen these base lines, all dimensions are given in reference to them. Again, take the identical case above used for illustration, and suppose the base line passes through the first place. In the machining of the second place, an error of ± 0.001 inch may be made; in the machining of the third place, a similar error has crept in, but as all measurements are taken from the base line, that error is within ± 0.001 inch from the base line, although it may be ± 0.002 inch from the second place. Suppose the next place be machined and a similar error made. That error is still within ± 0.001 inch from the base line and still within ± 0.002 inch from the theoretical distance to any of the other places. This condition holds true, no matter how many places there are to be machined and there is no accumulation of errors and no extra dimensions need be given.

The above illustrates very distinctly the advantages of the base-line method of dimensioning drawings. But in order to use it to the greatest advantage, the base lines must be chosen in the most convenient locations. The system will not work out if any arbitrary place be chosen as a starting point. By us, invariably, the base lines are drawn through the places that have to be most accurately machined. Should there be many places on the piece that have to be machined with equal accuracy, then any one of them will suffice. But it simply will not work to assume a base line at a place which will not be accurately machined, for the base line being the starting point, the result will be that all dimensions will be afflicted with its errors. This most accurately machined place may be of any shape, flat, round, or the center of a hole, but it must be the most accurately machined place on that particular piece.

As an illustration of the above, Fig. 1 is introduced. It is a drawing of the Elgin National Watch Company. Here the horizontal base line has been chosen to pass through two different circle centers, and the vertical base line through three circle centers. It will be noticed that all of the dimensions, both vertically and horizontally, are given from the base lines.

Fig. 2 is a drawing of a plate used in a calculating machine belonging to one of the most prominent calculating machine firms in the country. Here again it will be seen that all the dimensions are given from the vertical and horizontal base lines. Both of them have been chosen to pass through the upper main hole.

Development of the New Method

It will be seen that Fig. 1 contains about 50 dimensions, and Fig. 2 about 100 dimensions. Not long ago a certain drawing which contained about 200 dimensions was finished in our drafting room. As it represented a very important piece, I decided to check it myself. Now, it so happened that I had never before had much experience in dimensioning or in checking drawings, and soon commenced to "sweat" over the job. The drawing was dimensioned in practically the same manner as Fig. 2, and it took fully as long to find the dimension number as to check it; also, on account of the large number of parallel dimension lines, some of them close together, great care was required to avoid picking out the wrong number. Upon inquiring whether the drawings could not be dimensioned in some clearer manner and getting no satisfaction, I set to work and evolved the method explained below.

Upon analysis it appeared that the trouble was caused partly by the presence of so many dimension lines forming a complete network, and partly by the great distance from the dimension number to the corresponding part on the drawing. To cure the first fault I suggested the complete dropping out of all dimension lines, particularly those reaching down to the base lines, as being totally superfluous, because it was known that all dimensions were from the base line, and to cure the second fault suggested the placing of the dimension number immediately adjacent to its part on the drawing, or as close to it as possible.

To illustrate more clearly what was meant, Fig. 3 is introduced. It is a facsimile of Fig. 2, drawn to the same scale, so as to give as complete a chance for a thorough comparison as possible. It must be understood that Fig. 2 was all

finished, complete and in use, and that Fig. 3 was made afterward.

The first thing striking the eye is the complete absence of the network of rectangular dimension lines crossing the drawing. Of course, in practice, the attempt is made to distinguish between the drawing lines and the dimension lines by making the latter very faint, as is very successfully accomplished in Fig. 1. But in Fig. 3 they are completely left out, which not only saves the labor of putting them in, but brings out the outlines of the piece in much greater clarity. The next thing noticeable is the fact that all the dimensions are placed adjacent to their parts on the drawing, and in order to feel the difference it is suggested that the reader actually find, say, dimensions belonging to five different places upon Fig. 2 and Fig. 3. As an illustration: To find the horizontal dimension number of the lowest hole in Fig. 2, the vertical line through the center must be followed up to the top, care must be exercised to stop at the proper horizontal line, and at some distance along that line the number 0.6808 inch is found. In Fig. 3 the number is found immediately adjacent. Should it happen that in Fig. 2 the drawing is dirty, or the blueprint comes out faint in some of the lines, the chance for confusion and consequent error is very great, while in Fig. 3 it is almost nil.

Comparing Figs. 1, 2 and 3, we find that the differences are the following: In Fig. 2 *two* lines are required for each base dimension, one crossing the drawing, the other at right angles thereto. In Fig. 1 *one* line is required. In Fig. 3 *no* line is required.

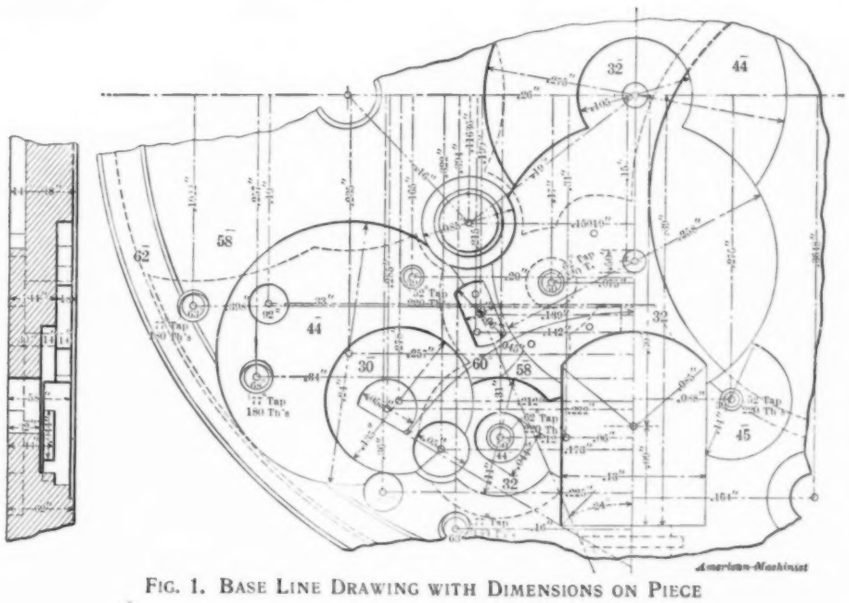

FIG. 1. BASE LINE DRAWING WITH DIMENSIONS ON PIECE

DIMENSIONS ADJACENT TO LOCATION

A further comparison soon brings out some more facts. Thus, in Fig. 1 the dimensions are not placed adjacent to their corresponding places and the difficulty in finding them is felt in only a less degree than in Fig. 2. The chance for error, because of the confusion of numbers due to the obliteration of the lines or the presence of dirt, is even greater than in Fig. 2.

As the method of Fig. 1 is a closer approach to that of Fig. 3, than is the method of Fig. 2, some more differences are pointed out. Thus, in Fig. 1 the vertical base line passes through three circle centers. To show their vertical dimensions clearly it was necessary to draw a short horizontal line through each, and then a long vertical line to the horizontal base line above. Compare this with the way in which in Fig. 3, the vertical dimensions of the three collinear circle centers to the left of the vertical base line are given. Here there are three small horizontal lines and that is all.

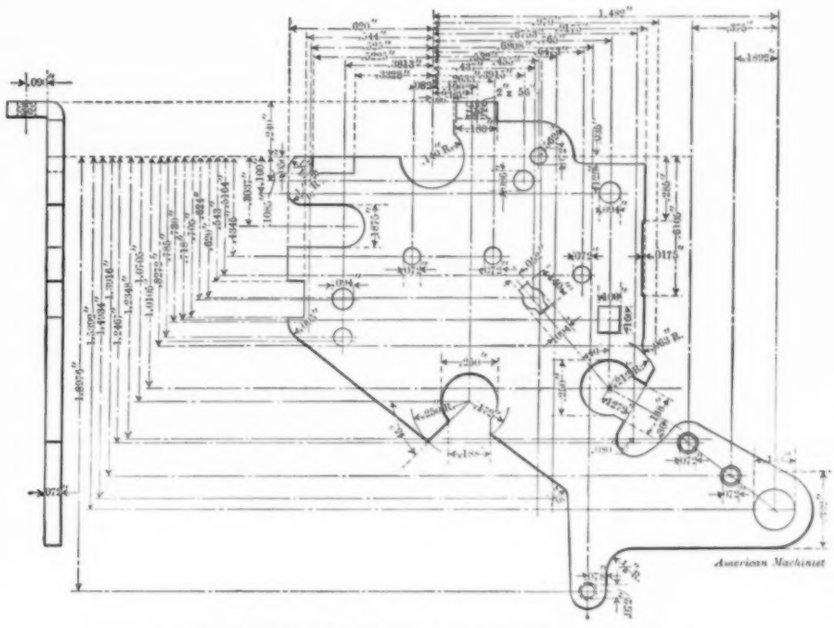

FIG. 2. BASE LINE DRAWING WITH DIMENSIONS OUTSIDE

IMPROVED BY USE

An actual trial of the new method shown in Fig. 3 soon developed some weaknesses. One was that, by itself, it was not sufficient for all purposes. Thus, at the bottom of the plate shown in Figs. 2 and 3, near the vertical base line there is an open hole. In both figures the dimension number 0.188 is found therein. While it is quite true that this particular dimension could be represented by base dimension numbers, the corresponding dimension on the obliquely opening hole at the right side of the figures could not be so represented. It was therefore suggested and adopted, that all base dimensions be identified by *tailless* arrows, while all local dimensions be represented by arrows *with tails*, and moreover these tails should form lines leading through the local dimension, to the places on the drawing. Thus, in Fig. 3, in the two open holes, the fact that the arrows are with tails shows immediately that they are local, or that the number 0.188 has nothing to do with the base lines. Similarly, for the number 0.14 at the complex hole (rectangular and circular) near the center of the plate.

At the time when this new method was first proposed there arose a considerable discussion as to whether it would cause confusion in the drafting room or among the workmen in the shop. The objection was raised that it was a new method and thus subject to error. It was decided to risk it. In actuality the men took to it like ducks to water. Since then the opinion has been many times

expressed that it saves much time and prevents many mistakes, not only in the drafting room, but also in the machine shop.

As time went on and it was found that the above method of representing base dimensions led to no confusion, but materially simplified the drawing, it was broadened out to embrace the representation of radii and diameters of circles. Again, glancing at Fig. 1, it will be seen that every circle has a diametral line drawn through it with two arrow heads on it, and the dimension somewhere on that line. In Fig. 2 a circle is represented by two tangent lines and two-tailed arrows. In Fig. 3 it is represented by a single tailless arrow placed obliquely, without any other lines whatsoever. Moreover, the fact that the dimension

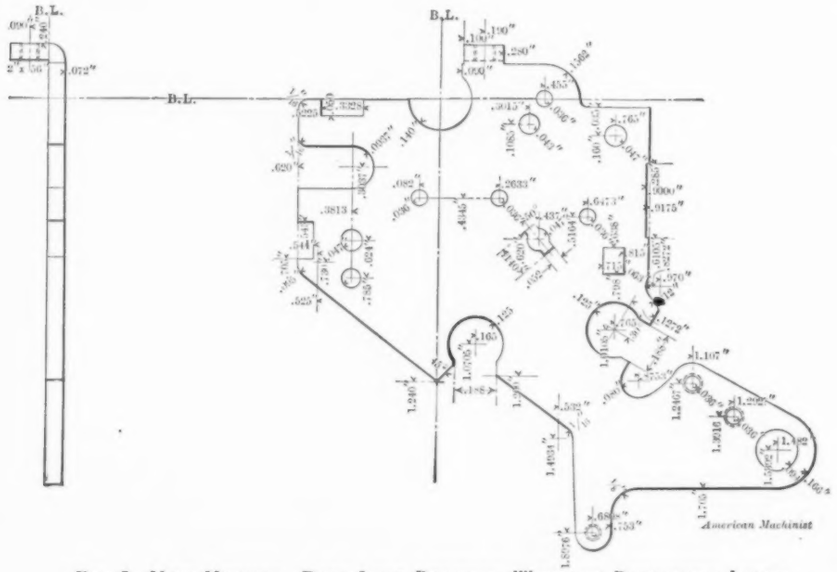

FIG. 3. NEW METHOD. BASE LINE DRAWING WITHOUT DIMENSION LINES. SAME PIECE AS FIG. 2

number is placed obliquely immediately indicates that it is a radial dimension.

ONE POINT OF DISCUSSION

Here, however, we struck for the first time an obstacle on which we could not reach complete agreement of opinion. What shall the oblique dimension number represent; the radius or the diameter? For considerable period there was no uniform method used for representing circles. Thus a complete circle was represented by a tailless arrow placed obliquely and the dimension of the diameter with a *D* placed adjacent. Incomplete circles like fillets and the open holes in Fig. 3, etc., used to be represented by an oblique tailless arrow, with the dimension of the radius and an *R* placed adjacent. But very soon there was proposed the adoption of only one; either one, but only one, so that both the *D* and the *R* could be discarded. A discussion followed and it was decided that as far as the drafting was concerned, it was really of no great moment which one was to be retained. In checking drawings to see whether fillets and lines were truly tangent, the radius was more convenient than the diameter. In the shop the workmen generally were used to the diameter of drills, reamers and screws. Our foreman, however, brought out the fact that in all his testing of center distances he measured over cylindrical plugs, and what he needed was radii, and not diameters. Again, in the making of studs, where various shoulders occur, it was more convenient to have radii than diameters. It was my opinion that, in order to make the method of representing circles consistent with the method of representing base dimensions, we ought to use the center as a starting point and thus give radii instead of diameters. We were not able to agree and are still undecided.

At present we use the radius in most of the work and the circle dimensions in Fig. 3 are such, but in a case like the screw represented in Figs. 4 and 5 we are still undecided. Fig. 4 shows the screw with the dimension numbers representing diameters; Fig. 5 shows the same screw with the dimension numbers representing radii. Comparing the two, we find that Fig. 4 has three arrow heads and three letters *D* which do not occur in Fig. 5; while Fig. 5 has the vertical line representing the axis of the screw which is not present in Fig. 4. Now, if we wish to find the amount of the shoulder formed by the head and the body of the screw, we find Fig. 5 more convenient, thus: $0.094 - 0.50 = 0.044$. Fig. 4 would give

$$\frac{0.187 - 0.100}{2} = 0.044.$$

So far the argument is in favor of Fig. 5. But when we reach the screw portion we find 0.094×56, to which we are accustomed, while it gives us quite a jolt to read 0.047×56, as being totally unusual and radically different. But upon questioning ourselves we find the difficulty to be limited only to the fact that it is unusual and different and nothing more.

We are still arguing whether to use the diameter or radius. So far we use a mixed system, as indicated above, but are dissatisfied with the mixture. We would be very glad to hear the opinions and criticisms of others, and if it be possible, adopt a uniform system in the representing of a circle, by either radius or diameter, but always by the same one.

DIMENSIONING ANGLES

Having broadened out the above-described method to include horizontal dimensions, vertical dimensions and circles,

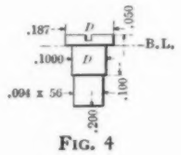

FIG. 4

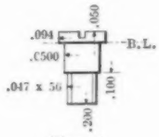

FIG. 5

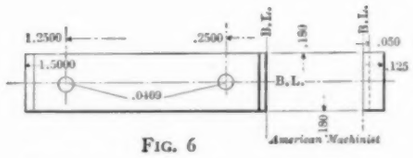

FIG. 6

EXAMPLES OF APPLICATION TO SIMPLE PIECES

it was proposed to extend it to include angles. Again referring to Fig. 1, it will be seen that there are given two angular measurements, one of 24 degrees, the other of 60 degrees. In each case the angle is represented by a faint dimension line, a faint circular arc with two arrow heads, one at each end, and the number of degrees written somewhere on the arc. In Fig. 2 the angles 45 degrees, 30 degrees, and 40 degrees are represented in a manner similar to Fig. 1. Further examination also shows that in all of the above cases the angle is always measured from either the horizontal or the vertical as a starting line. So the suggestion was made that either one, but only one, be adopted as a standard starting line for angular measurements and the employment of the circular arc and one arrow head be abandoned as totally superfluous, which was done. The new method of dimensioning angles can be very clearly seen by examining the three angles 45 degrees, 30 degrees and 40 degrees, shown in Fig. 3. For the present we assume the horizontal as starting line, because that is the line assumed as such in all treatises on analytical geometry. But here again, if any

overbalancing argument be submitted, we will change.

Should any local angles have to be indicated, it can be done by arrow heads and circular arcs, as in the ordinary manner. In our work not a single such case has as yet arisen.

There has now been shown and described our new tailless-arrow method for representing the horizontal, vertical, radial and angular dimensions. The question might now be asked: To what extent has this method been adopted in our establishment? The answer is: Completely. There is not a trace of any of the other methods used. Are we satisfied? Most assuredly so.

We are often asked whether this method of dimensioning applies as well to the drawing of simple parts, as to more complicated ones. It most certainly does. As illustrations, Figs. 4 and 5 are referred to. Again, Fig. 6 shows a small formed piece and here also the base-line method is used. We use no other.

Attention is also called to the fact that Fig. 1 shows every dimension accompanied by " (inch marks); so does Fig. 2. Figs. 3, 4, 5 and 6 show not one. In our establishment we use nothing but inches, and this is the case with the other shops where the Figs. 1 and 2 were made. For this reason inch marks were dropped. Furthermore, the degree of accuracy required is shown by the number of decimals in the dimension.

Again comparing Figs. 1, 2 and 3, we find that in Fig. 1 a tapped hole is represented thus: 52 Tap 220 Th's. In Fig. 2 a simpler scheme is followed: A tapped hole is represented thus: 2x56, but the drawing itself shows a series of oblique lines to indicate the threads. Compare this with Fig. 3 where the tapped hole is represented by two parallel lines and the designation: 2x56. Is it not simpler? Is it not sufficient?

We claim no credit whatever for the abandonment of the inch marks and of the inclined thread lines, as these are quite old. But the method of representing dimensions, horizontal, vertical, circular, angular, or any of them, by means of a tailless arrow referring to some standard base, was completely unknown to us until it was developed in our own establishment, step by step. Considerable inquiry on our part has brought out the fact that surveyors use something similar in representing their rectangular dimensions. We have not seen that system and we believe it is limited simply to the rectangular dimensions. We are very proud of our system, as in our opinion its use results in a great simplification of the work and saving of time.

Jigs and Fixtures in a Grinder Shop

By Ulrich Steiner *

An internal milling fixture for the equalizing rings of a speed changing mechanism.

An interesting drilling jig and its use in connection with facing tools.

How alinements are secured.

*Superintendent, Landis Tool Company.

Fig. 1 shows an internal milling fixture for the equalizing rings, which are a part of a speed-changing mechanism. Reference to the halftone shows the fixture to be made up of two parts *A* for holding the rings which have been previously drilled, and *B* the fixture for milling the inside bosses of the rings shown. This fixture *B* is also made up mainly of two parts, the slider *C* which is fastened by filister-head screws to the milling-machine table and the stationary head *B* in which are the gears for driving the two cutters.

Fig. 2 shows the driver with trunnions on each side of the gear. These trunnions fit a reamed hole half of which is in the cap Fig. 3 and half in the body of the head *B*, Fig. 1. The hole *C* in the driver, Fig. 2, is reamed and fits a one-inch milling machine arbor, provision also being made for a key. Fig. 4 shows the driven gear with threaded portions on each end to which the cutters are screwed. The threads are necessarily, one right- and the other left-hand. As the distance between the bosses in the rings is but 3½ inches it will be seen that the bearings were necessarily very short. To help out, four hardened-steel rings were provided, two for the driver and two for the driven. After these parts (driver and driven gears) were turned, ground and the teeth cut, the hardened-steel rings were then ground the exact pitch diameter of the respective gears. Special care was also taken to exactly space the holes in the head for the driver and driven gear. The bushing, Fig. 5 is made of special bronze and is press fit in the body *B*, Fig. 1. A pivot pointed screw is also provided for holding the bushing in place. At one end of the bushing is a reamed hole into which the trunnion of the driven gear fits, forming a small bearing, on the same end, but on the inside, the bush is bored to fit the steel ring which was ground to the pitch diameter, this also with the outside diameter of the gear forms the bearing. To assemble, the driven gear is placed in the bushing, next the bronze ring, Fig. 5, is slipped over the steel ring and lastly the bronze disk, Fig. 6, is screwed into the head and is locked by a taper screw at *G*, Fig. 7.

It will be seen that a rolling action takes place between the rings and thus some of the thrust of the driven gear is taken up or absorbed by the ample bearings of the driver. When in operation the head remains stationary, while the slide and ring-holding fixture are moved along with the table thus feeding the work to the cutters.

Machining the Bosses Inside the Bed

Fig. 8 shows the drilling jig and tools

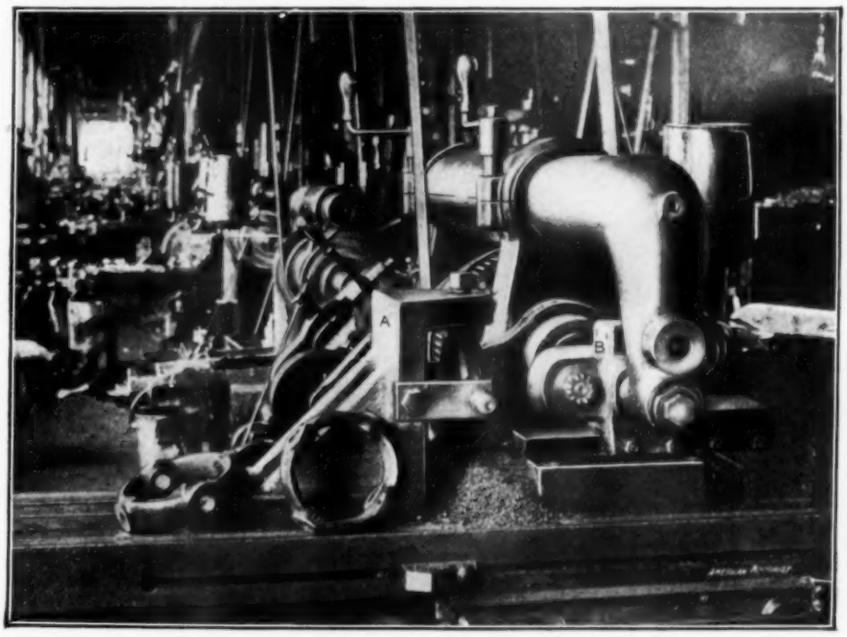

Fig. 1. An Internal Milling Fixture

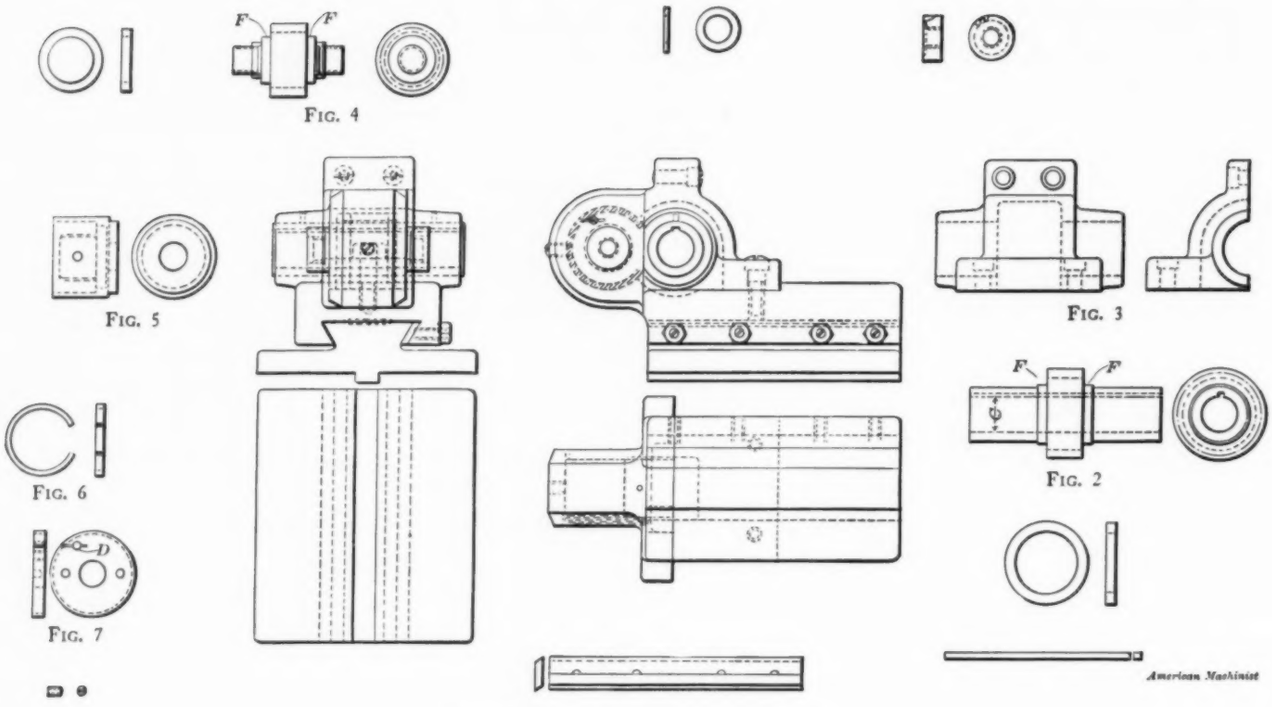

Fig. 4 Fig. 5 Fig. 6 Fig. 7 Fig. 3 Fig. 2

MILLING FIXTURE FOR EQUALIZING RINGS

for facing the bosses, inside the bed, to which is bolted the gear frame. Special care is taken to face these bosses so that a plane touching their surface will be square with the hand-wheel shaft in every way, as upon this depends the proper meshing of the bevel gears, a very important feature. Too much care cannot be exercised and hence the tools shown were brought into use. The jig for drilling the holes is shown resting against the bed in the halftone. The pivot *A* in the jig fits the handwheel shaft bushing which is previously placed in position; a finished portion of the jig is brought to bear on the top of the bed (which is planed) and is then firmly clamped in this position. The drilling is next in order, after which the holes are reamed. The jig is then removed and the facer bar *B* inserted, next the cutter *C* is slipped over the end and held in position with a cone-pointed set screw. Fig. 9 shows the test square which is now brought into use and which is made up of a round piece and a hardened-steel blade fastened at one end.

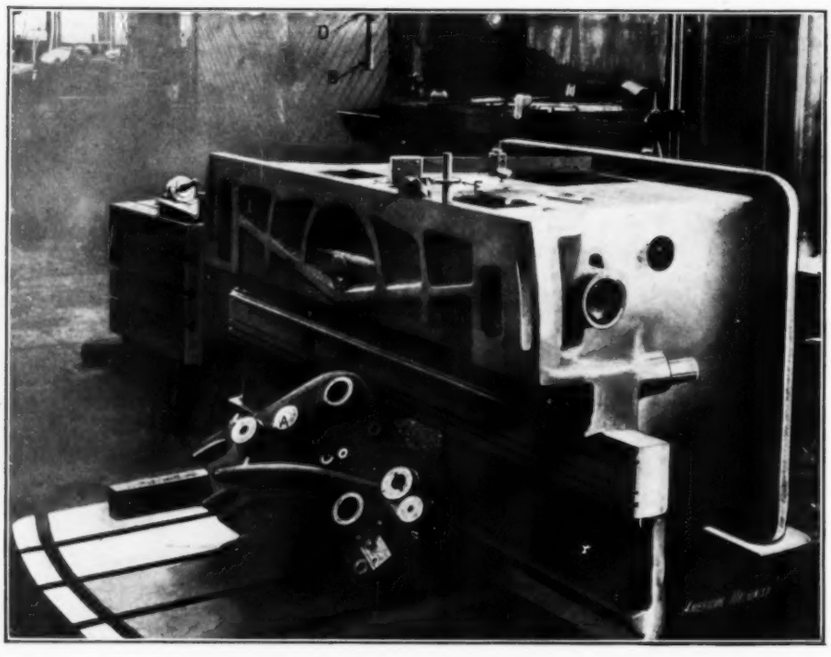

FIG. 8. DRILL JIG FOR THE BED

HOW THE TEST SQUARE IS USED

This blade is provided with a sliding head for holding an indicator, the round portion fits the handwheel shaft bushing as shown in Fig. 8. The bosses are then faced till the blade just passes the collar *B* which is set the proper distance from the cutting edges of the facing tool.

Next the plug *E*, Fig. 8, is inserted from the inside of the bed the flange being held firmly against the boss, and the indicator which is held in the sliding head is passed over the end of the plug and

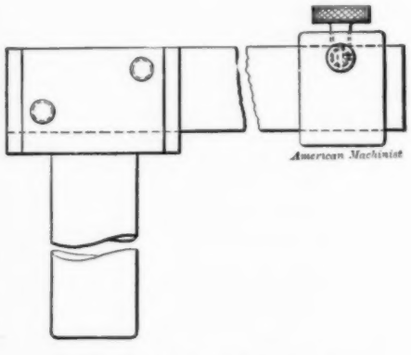

FIG. 9. THE TEST SQUARE

the reading noted. All of the bosses are thus tested and by retouching with the facing tool are brought exactly to the same reading. In this way excellent alinements are secured and consequently smooth running gear frames which require very little attention are the result.

Overhead Charges and Shop Output

By Holden A. Evans*

The relation of overhead charges to total cost is little understood except by experienced managers and by those who have made a study of the subject. An analysis and study of the overhead charges by a competent manager is necessary for the efficient working of an industrial plant. Superficial criticism of these charges, and action taken thereon, however, may result in a decrease in efficiency.

What constitutes overhead charges and the fallacy that reduction in them means reduced shop costs.

Notes on good shop management with particular reference to its relation to overhead expenses.

Suggestions for expense analysis forms.

*Naval constructor, United States Navy.

The Works Manager Versus Financial Control

In nearly all cases in industrial life the "operating expense" is a bone of contention between the financial control and the works manager. In many cases, yes, in the majority, the financial end of the establishment knows nothing of shop management, but is well informed regarding accounting methods and knows the effect produced on stockholders and the general public by a statement of high operating expenses in the annual report. High operating expenses do not look well in financial reports, and it is often very difficult for the works management to persuade the financial power that in many cases high operating expenses result in efficiency and lower cost of the output. If the establishment is a manufacturing concern where the cost can be accurately determined, and compared with previous costs, or with costs of competitors as shown by their selling costs, the works manager has an opportunity to prove his side of the case, but if it is a jobbing concern, or a repair plant similar to a navy yard, where no such comparison can be made, the manager has little opportunity for proving his case, and he will, in many cases, be required to reduce the operating expense, although he knows that such reduction means a loss to his company. This is a disheartening experience which is forced on many managers.

Ignorance of the Relation of Overhead Charges to Total Cost

The lack of knowledge of the relation existing between overhead expense and total cost is by no means confined to the financial power, as it even sometimes extends to managers themselves. It is astonishing how little is known concerning this subject. Some good business men, men who should know, have failed to grasp the true meaning of overhead expense and its relation to the total cost. I know of one important repair establishment which makes large repairs for another concern on the basis of actual cost plus a percentage of profit. The manager of the concern for whom the repairs are made is considered an excellent business man who can drive a hard bargain. The manager of the repair establishment well knows that endless trouble will ensue if the bill presented contains the proper percentage of overhead charges, so the bill shows about half the actual overhead expense, with the direct charges padded to make up the balance. So great is the ignorance regarding proper overhead charges that some concerns which do much work on the basis of cost plus a percentage of profit, keep their books so that much of what is proper overhead expense is charged as direct labor, in order that they can show a customer a moderate overhead charge. Many actually do not know what goes to make up the overhead expense. Very few outside of experienced managers know that much productive labor, or to make it clearer, direct labor, cannot be charged directly to a job, as this labor is employed on several jobs at the same time, and must necessarily be distributed to the jobs either on the basis of direct labor charged or on a tonnage basis.

Mfg. Dept.

Account	Symbol	July		August	
		Labor	Mat'ri	Labor	Mat'ri
Superv'y. & Office Force	D A				
	D B				
Fixtures & Furniture	D C				
	D D				
	D E				
Tools	D F				
Tools Special	D G				
Tool Room Labor	D H				
	D J				
	D K				
	D L				
R. & M. of Machinery	D M				
	D N				
	D O				
Prop. Power Charge	D P				
Miscels. Labor	D Q				
Correction of Errors	D R				
Genl. Stores & Supplies	D S				
	D T				
	D U				
	D V				
	D W				
	D X				
	D Y				
R. & M. of Buildings	D Z				

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FORM 1. ANALYSIS OF SHOP EXPENSE

Many do not know that certain material must be charged in the same way, and that this material, though it appears in the overhead charges, is actually used on the job.

I have heard those in a position to criticize, in a position where the criticism would be accepted as of value, express the most severe criticism of the management of a shop where the prorated charges, including general expense, amounted to 100 per cent., stating that it cost as much to run the shop as it did to do the work in the shop! It was thought that the overhead expense consisted of charges for the supervisory force, clerks, cost of power and minor repairs to tools. It was not considered possible that in any well managed establishment, the overhead charges could amount to 100 per cent. of the direct labor charged. It is needless to say the one making this criticism never had the opportunity of analyzing the overhead charges in a large well conducted foundry where costs are accurately determined. Such is the ignorance with which managers have to contend.

Danger of Superficial Criticism

In repair plants, or in establishments where work of large magnitude is undertaken which requires several years to complete, as in shipbuilding, it is difficult to compare costs or to measure the output. Frequently, also, the supreme control of the establishment is in a city office far distant from the plant, and knowledge of the operation of the plant is obtained from monthly reports and an occasional visit. Under these conditions direct costs and total costs cannot well be criticized, and the criticism therefore, naturally turns to the expense account. There is apparently something in overhead charges which attracts the criticism of nearly everyone, for one hears criticism of these charges from those who have little idea of what goes to make up these charges and who have not a faint conception of the subject in its bearing on total cost. This tendency must be due to the belief that the payment of money for overhead expense is expenditure without adequate return.

Superficial criticism of the expense accounts by those in authority will probably result in decreased efficiency.

In one large establishment with which I am familiar the shop-expense accounts are kept down to the lowest point without regard to the efficiency of the tools in the shops. I was shown the care taken to keep these expenses down and was told how the expense had been cut in half and that it was believed that the concern had a lower shop expense than its competitors. The shops surely showed

it—there was no necessity for seeing the accounts. Machines were in poor condition; belts were as bad as they could be; the small tool equipment was atrocious. Moreover, the foreman on every opportunity charged shop repairs to the direct cost of some big job in the shop, rather than charge to the expense number. There is not the slightest doubt that the blind effort of someone in authority to reduce shop expense is resulting in large losses to this concern.

When a concern begins to lose money and the order is given to economize in the hope of changing losses to profits, it is almost invariably true that reductions will be immediately made in the overhead expense, notwithstanding the fact that the remedy required may be more and better supervision and consequently higher overhead. When the expense account is cut, the majority, including some managers, feel that the cut is just so much saved. The increase in direct costs cannot be seen; it may actually be several weeks or months before there is a direct increase, as the momentum of past conditions cannot be dissipated immediately. There is little doubt that the effort made to economize by cutting the overhead expense has carried many establishments to ruin. Unfortunately, overhead expense is generally known as a percentage of the direct labor charges, and the more the efficient manager reduces his direct labor costs, the higher his overhead expenses appear to be. There are given below several examples of shops which have come directly under my observation in which the subject of shop expense required intelligent consideration. In each case the increase, either real or apparent, of the shop expense meant increase in efficiency while the decrease resulted in a reduction in efficiency.

The Shop with Machinery in Poor Condition and with a Poor Equipment of Hand Tools

An experienced manager who knows his business well knows that if he is to get work done at low cost, he must supply adequate tools with which his men are to work. One can in practically all cases judge of the efficiency of a shop by an inspection of the machinery and the tool-room equipment. A well equipped shop is not always an efficient shop, but it is certain that a poorly equipped shop with machines and hand tools in bad condition is never an efficient shop. The higher the wages, the more important it is to provide an excellent tool equipment.

A short time ago an important shop, located in a district where wages are very high, came under my observation and I found the tool equipment in atrocious condition. The costs were excessive and it was surprising that these conditions should have existed so long

Mfg. Dept.					
Account	Symbol	July		August	
		Labor	Material	Labor	Material
Salaries Civ. Ass'ts.	BA				
Yard Maintenance	BB				
Clerical Force	BC				
Drawing Office Total	BD				
Miscel. Wages	BD A				
Stores & Supplies	BD S				
Tests & Inspections	BE				
Industral Yard Craft	BF				
Heat, Light & Pr, Total	BH				
Labor	BH A				
Fixtures & Furniture	BH C				
Plant Repairs	BH E				
Fuel	BH F				
Lighting Ships	BH K				
Current Mfg. Dep't.	BH L				
Stores & Supplies	BH S				
Outside Piping & W'r'ng	BH W				
Water, Gen. Purposes	BH Z				
Care of Dry Docks	BJ				
Holliday	BK				
Leave	BL				
Disability	BM				
Office Maint. & Rep's.	BN				
Office Stores & Supplies	BO				
Yard Machinery	BP				
Store House, Part					
Inspection & Tests	BQ				
Minor Repairs	BT				
Handling Stores Miscel.	BU				
Handling Stores Rwy.	BV				
Handling Stores Genl.	BW				
Fire Protection	BX				
Telephone & Telegraph	BY				
Buildings	BZ				

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FORM 2. ANALYSIS OF GENERAL EXPENSE

without correction. If low shop expense percentage is the aim, it is easily accomplished by not spending money to bring the tool equipment up to a proper standard. Not only is the actual expense kept low, but the expense *percentage* shows very low as the direct labor cost to which the expense cost is applied to obtain the percentage is very high.

The Shop in Which High-priced Mechanics Are Employed on Work That Should Be Done by Boys and Helpers

A great many Government shops fall in this class, though the Government has no monopoly in this line. I recently had occasion to investigate a boiler shop and found everywhere first-class boilermakers doing work that should be done by boys and helpers. Boilermakers were cutting off tubes, filing the burs after the tubes were cut, polishing the ends of the tubes, placing the tubes in position, attending the motors driving the expanders and other work of this character. A competent manager knows the work that should be done by boys and helpers. He is in touch with the best industrial practice. He knows what the other fellow is doing. Such a manager will replace his $4 a day boilermaker with $2 helpers and $1 boys wherever possible. He will reduce costs. But what is the result with his shop expense? For every dollar that he reduces his direct cost, his percentage of shop expense goes up. If it were possible for him to replace all of his $4 boilermakers by $2 helpers without reducing the output, he has reduced his direct costs by half and *doubled* the shop-expense percentage.

In Government shops and also some commercial shops, if the aim is to reduce the shop-expense percentage, this can readily be done. No effort is required by the manager; all that is required is for him to do nothing—the percentage will go down of its own accord. The foreman had rather have mechanics than helpers any day; they require less supervision, less inspection; they give him less trouble. Besides, he has no desire to get in trouble with the unions, and the members of the unions are his best friends. He, therefore, employs mechanics wherever possible rather than boys and helpers wherever possible. The result is a large labor roll and a small percentage of shop expense.

The Shop in Which Work Is Done by Hand Instead of with Machines

The boiler shop previously referred to is an excellent example of this class. Tubes were cut out by boilermakers with sledges and hand chisels. Tubes were expanded in some cases by hand-operated expanders. Boilermakers with hand files removed the burs on the tubes made by the cutting-off saw. All of these hand operations were replaced by machine operations and the direct labor cost greatly reduced, the total cost was reduced, the labor roll was reduced, but the actual shop expense was slightly increased, and the shop-expense percentage was largely increased.

If the manager could replace every hand operation by machines, that is, use altogether automatic machinery, he would no doubt enormously reduce his direct cost and total cost, but he would greatly increase the shop expense and the shop-expense *percentage* would reach infinity. Surely no one would criticize such a manager for high shop expense, yet today one hears criticism as senseless as this.

The Shop in Which the Output Is Low and There Is Much Loafing

If a manager takes over a shop in which the output is low, where the men are not doing a full day's work, and succeeds in bettering conditions and increasing the output per man, he will for the same amount of work reduce his

labor roll, but at the same time increase his shop-expense percentage. Surely such a manager is not to be criticized. It would be just as sensible to commend the manager who acquires a well run shop and allows his men to loaf to make a larger labor roll in order that he could show a reduction in his shop expense.

Other Methods of Reducing Shop Expense

There are other methods than those previously indicated by which the shop expense may be reduced without any increase in efficiency, or which may result in a decrease in efficiency. In many shops, for example a foundry, there is much miscellaneous labor employed on many different jobs. This labor cannot equitably be charged direct to jobs, therefore in well conducted establishments these charges are made to the expense number for miscellaneous labor which cannot be charged direct, and is distributed to the jobs either on a tonnage or direct labor basis, as an indirect charge. Those who wish to make a good showing with the indirect charges frequently arbitarily charge this labor direct to jobs with the result that a few large jobs bear this expense while the small jobs get none of it.

So eager are some to make a good showing with the expense accounts that frequently men employed as leading men, or strictly in a supervisory capacity, though not known as foremen or assistant foremen, are charged direct to the jobs instead of being properly charged to the supervisory number. The only result of charges of this kind is to make the costs less accurate, and fool someone in authority into believing that he has through good management obtained low expense accounts.

Comparison of Overhead Expense Percentages of Different Establishments Means Nothing

Even though establishments of the same general character have the same cost-keeping system, which is far from being the case, a comparison of the expense accounts is of little value, and a comparison of the expense percentages is a waste of time. Before there can be a comparison of any value of expense accounts, the detail methods of charging must be standard, the methods of management must be standard, the facilities must be very much the same, and the working conditions the same. An establishment having the highest expense charges may easily be the most efficient while the one with the lowest may be the most inefficient. The overhead charges are in no sense a measure of the efficiency of a plant; the only measure of efficiency is *total* cost, and I care not how high the overhead charges go so long as the *total* cost is right.

How Can Proper Control of the Expense Accounts Be Secured

The analysis, study and control of the expense account is a most interesting field to the manager of experience who knows his job. It is Greek to one who does not. If you have enough confidence in a manager to place him in charge of your establishment, let him control the expense accounts; do not tell him to reduce expenses by cutting the expense accounts; if the product is costing too much, it may be that the cost may be reduced by increasing the overhead; hold him responsible for total costs and not a portion of the total costs.

The cost-keeping system should, however, be such that an inspection will readily show where the overhead charges have gone. Each month there should be prepared for the manager a complete analysis of the expense accounts. These can best be shown month by month in parallel columns.

Form 1 gives the analysis of the shop expense. Each shop should, of course, have a separate expense account, subdivided as necessary, and there should be an analysis sheet for each shop. With this sheet before him for each shop a manager can tell exactly where the money is going. He can see at once any abnormal expenditures and find out the cause. He should have each charge investigated until he has obtained a *working minimun* and thereafter he will only have to deal with the exceptions.

Form 2 shows the analysis month by month of the general expense. I prepared this for navy-yard administration and it does not include a number of expenses which must be taken into account in commercial establishments, such as depreciation, insurance, etc. This analysis should be studied and treated as described for the shop expense.

Form 3 is a summary of all the expense accounts showing the expenditures this month, last month, and the average of the year to date. It also shows the direct labor charges in each shop and the percentage of each class of overhead to the direct labor charged.

With this information a manager should be able to absolutely control the expense accounts.

Mfg. Dept.

Account	Symbol	This Month					Last Month				Aver. this yr. to date			
		Labor			Material		Labor		Material		Labor		Material	
		Direct on Output	Indirect		Indirect		Indirect		Indirect		Indirect		Indirect	
			Amt.	%	Amt.	%	Amt.	%	Amt.	%	Amt.	%	Amt.	%
General	B													
Sheet M.W'k'r.	DA													
Boat Shop	DB													
Plumber & Pipe Ft.	DC													
Foundry No. 2	DD													
Electric Shop	DE													
Flag Shop	DF													
Smith Shop	DG													
Coppersmith	DH													
	DI													
Joiner & Sawmill	DJ													
Shipfitter	DK													
Laborer	DL													
Machine Shops	DM													
Boiler Shop	DN													
Foundry No. 1	DO													
Pattern Shop	DP													
	DQ													
Rigging Loft	DR													
Shipwright & Sparmaker	DS													
Sail Loft	DT													
	DU													
	DV													
Paint Shop	DW													
	DX													
	DY													
	DZ													

American Machinist

Form 3. Monthly Summary of Expenses

Machine Work at a University

By J. H. Gill *

How college work differs from manufacturing and its effect on the student.

Building gas engines as a regular product to give commercial requirements and results.

Using the time clock, time records and possibly the premium plan.

*Assistant professor of machine construction, University of Illinois.

There have appeared of late many articles on the subject of shop education, which is a hopeful sign. We learn from the experience of others as well as from our own. Dean Schneider, of Cincinnati, has inaugurated a plan which seems to be working well in that city. It does not seem as feasible in some other localities where the surroundings are less favorable. Cincinnati is the seat of the machine-tool industry, and there are many other lines of work there that make the conditions exceptionally favorable to such a plan.

A good many of our engineering schools are situated in towns where there is little or no manufacturing, or other mechanical work. The course extends

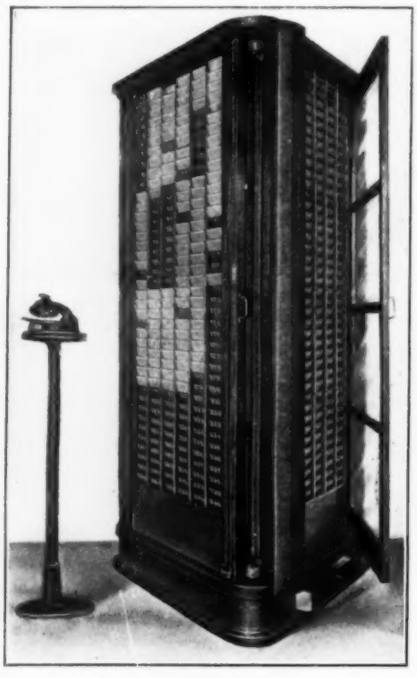


FIG. 1. TIME STAMP AND CARD RACK

over four years. Crowded in those four years we find many and varied subjects. The general culture studies have been cut to the quick. No one will contend that the engineering student gets more language, history, economics, physics, chemistry or mathematics than is necessary. The technical subjects require all the time that it is possible to give to them. The courses in mechanical and electrical engineering at least, usually include brief courses in pattern, forge, foundry and machine shops. Students enter these courses from the high school with little or no knowledge of shop work of any kind. In the brief time allowed for these courses in shop work, what can be given that will put the student in the best condition to meet the situation which will confront him when he gets through his course? All who take these courses should have some knowledge of shop work. The more they have, the better. Those who go into work connected with manufacturing must have a more intimate knowledge than can be had in the time and under the conditions of the college shop. These must expect to go into the shop after graduation and get the intimate working knowledge of the particular line that is necessary. It is impossible in the school shop to give much emphasis to skill in producing nice, accurate work. The principles involved in the various kinds of work, the various machines used, and something of the capacity of these machines can be shown. The value of time is one of the important things and the most difficult to impress on the student.

MAKING A REGULAR PRODUCT

We, at the University of Illinois, are trying out a plan that promises to be an improvement. We have realized that to do the most for a student, we must get and hold his interest. To do this, we have, among other things, been building gasolene engines for several years. In that time, we have developed a gasolene engine of the marine type, two cylinder, four cycle, that will give about seven horsepower. This is of such size that the parts can be handled with the equipment available. The gasolene engine is a subject that appeals to the interest of the student. It is complete in itself. It will go and does not require a motor or an engine to run it. It is better than a steam engine in that no boiler is required. Nearly all students, or some of their relatives, would like to get a small engine. If the student is making an engine for himself or for some friend, he will take a much greater interest in the work than if he is making some piece of apparatus for the school. We have fitted up with jigs and fixtures and are making these engines in lots. We push the production as if this was the object we had in view. In reality, it is only a means to an end, and that end is the student.

A time clock has been installed. The work is given out on numbered shop orders. Time is kept on each operation. Each student has a number. Near the time clock there are three racks, with a pocket for each student in each rack. The racks are marked "Jobs Ahead," "In," "Out." Orders are made out for the work and placed in the "Jobs Ahead" rack. The student comes in, goes to the rack and takes out his order, stamps it, puts it in the "In" rack, and begins his work. At the end of the period, he takes the card, stamps it and places it in the "Out" rack. When he comes in again he stamps the same card and puts it in the "In" rack. When he has completed the order, he stamps the order card and drops it in the "Completed" box. He then gets his next order and begins that. The work is carried through in job lots and made as nearly on the interchangeable plan as possible. The finished parts are inspected, and if within the limit,

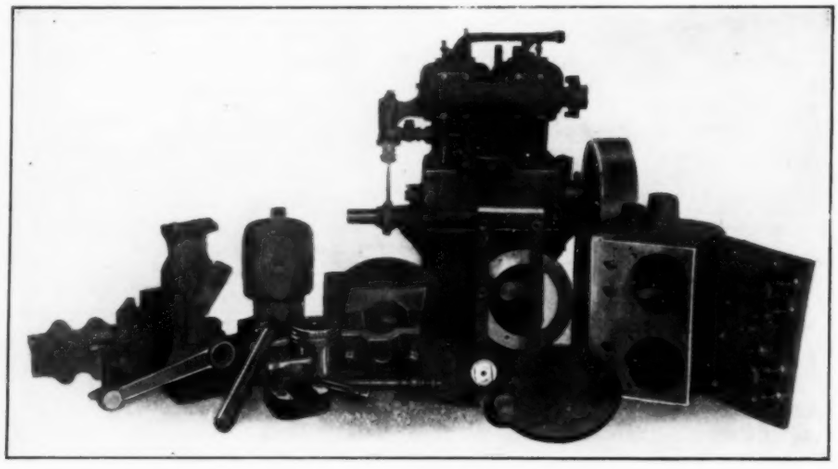


FIG. 2. THE ENGINE, ITS PARTS AND JIGS

they are put in the rack from which the finished engine is assembled.

How It Differs from Manufacturing

There is one important difference between our way of working and that of a manufacturer. We push the men along from one job to another. We assign a student his work through the cards in the "Job Ahead" rack. This work has been planned, piece by piece. The order of operations has been thought out in the design of the fixtures. A student will get an order to bore four cylinders, for example. He takes his castings to the lathe fitted with a fixture for this job and bores one cylinder after another. His tools are good and stiff, his work is held rigidly, and he crowds the work to see how good a record he can make. When he has these cylinders bored and reamed, he takes them with the order card to the instructor, who checks the work and grades it in the presence of the student. He then deposits his order card in the "Completed" box and begins on the next order.

The instructors make out in advance several cards for each student, and when any student is in need of a new job, the instructor selects it from those in the "Job Ahead" rack. In this way the work may be selected to suit the conditions in the shop. If a student's next order card calls for the use of a certain milling machine, for example, and that machine is in use, the instructor selects from the cards in the student's "Job Ahead" pocket the one that can be handled in a machine that is available.

If the instructor takes the class or a group of students away from assigned work for any cause, he puts the student's numbers on a red card and stamps it "In" and "Out" for the time taken. This time is deducted from the total time of the student on his order card.

We expect to establish a time record on each operation, and possibly we can later introduce some form of "premium plan" of grading the work.

Some of the Methods Used

Fig. 1 shows our time stamp, which has electric connection to a master clock, and two of the three order-card racks. These racks are built together into a triangular form and each rack has a glass door, which pockets behind the other rack, as shown. This enables us to lock the rack at any time and prevent late students stamping in. Fig. 2 shows the engine and a part of the jigs used; also a number of the parts. Fig. 3 shows the crank case under the radial drill ready to have the seats for the cylinders bored out through the jig *A*, by the cutter head. *B* is the jig for boring the holes for fastening the end bearing and plate to the crank case. *D* is the jig for drilling holes for the hand-hole cover plates. *C* locates all the small holes in the top of the crank case. The three flat faces of the crank case are milled with an eight-inch face mill, having high-speed steel cutters.

The sample order card shows quite clearly how the orders are made out. On the back of this card the operation to be done is checked so there is no chance for mistake as to what is covered by the card.

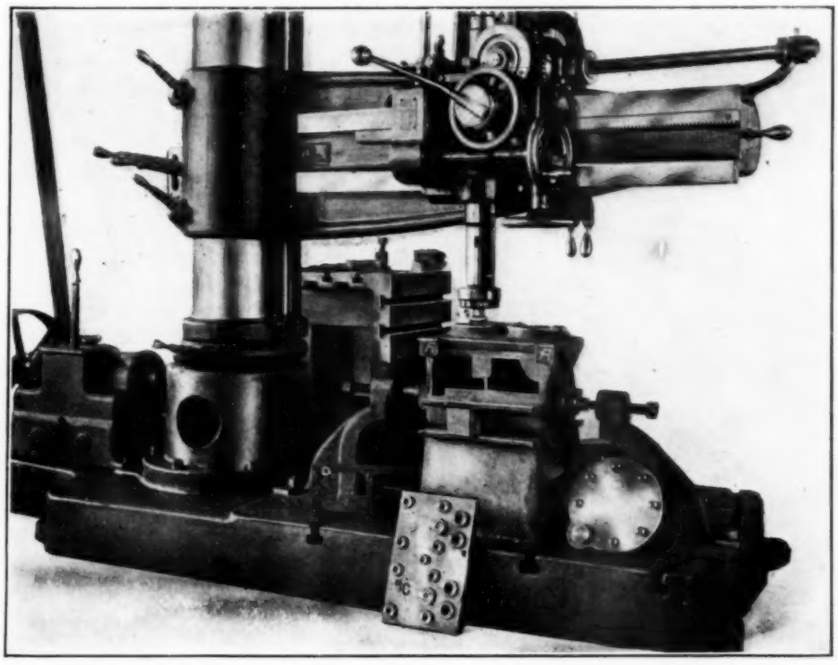


Fig. 3. Boring the Crank Case

University of Illinois
Mechanical Department Shops

ORDER CARD.

Name..... No.....
Job No..... Piece No.....
Name of Piece.....
Make.....Pieces
Use Machine No..... Jig No.....

Time Record.	Hours.		
			STARTED
			OUT
			IN
			OUT
			IN
			FINISHED
Total time			
Deduct			
Next time			

This Side Out

OPERATIONS.

The instructor will fill out the order card, check the operation in space below, and place in "job ahead" rack *before* it is needed by the student.

	Adjusting		Painting
	Assembling		Planing
	Babbitting		Polishing
	Boring		Punching
	Chipping		Reaming
	Cutting off		Recitation
	Drilling		Repairing
	Erecting		Sawing
	Facing		Screw machine
	Filing		Shaping
	Finishing		Tapping
	Grinding		Testing
	Inspection		Threading
	Key seating		Turning
	Milling		Turret lathe

Remarks:

Pieces Spoiled 0 0 0 0 0
Punch here.

When we get the manufacture of this engine worked out, we hope to take up other things, in order that we may add variety to our work.

We propose to sell the engines to the students for the cost of the raw material. When we take up another problem, we will find a way to use it in our shops or laboratories, send it to other institutions, or in some way dispose of it other than to put it on the market. Being a State institution, we would not be expected to enter the market with our product.

This work is intended for the second semester of the course in machine shop. The first semester is a course of exercises to give what we call machine manipulation. These exercises are mostly parts of a small bench grinder. It is

designed with the main idea of using the parts as exercises. The parts that are O. K. within the limits are assembled into a complete grinder.

This first semester gives practice in machine work with few, if any special fixtures. The exercises are worked out with the ordinary tool-post tools, calipers and scale. The student gets some knowledge of the handling of machine tools and the difficulties and time required to produce good work. The work of the second semester stands out in strong contrast to this, and impresses the student with the value of modern shop methods.

As the plan works out, we hope to extend it or a modification of it to the other shops.

There are a number of details that are to be improved, but the general plan is working well. The object is to give the student as much as possible in the limited time available. He gets some knowledge of the manipulation of machine tools, their capacity and range, and then is strongly impressed with the advantage of special machines, jigs and fixtures in the production of work by modern manufacturing methods.

Broaching on the Power Press

The halftone, Fig. 1 illustrates a geared press, equipped for broaching the square wrench holes in the ends of chuck screw blanks. One of these blanks is shown in the sketch, Fig. 2.

This machine is built by the V. & O. Press Company, Glendale, L. I. It is fitted up for handling five sizes of screw blanks and five feed dials will be noticed in the first illustration, one of these being in place upon the machine, while the other four are shown leaning against the left-hand side of the press. Five blanks of different sizes will be seen resting upon end on the dial in the press. The holes in the blanks range from 3/16 to ½-inch square.

The screw blanks come to the press with a hole drilled at one end of about the size of square required. The hole is slightly deeper than is necessary for the squared opening, and this extra depth permits the single square tool which is used to be forced down to the proper depth, the chips being compressed at the bottom and a perfectly clean, flat surface formed by the end of the punch.

The stripper plate which prevents the blanks from being lifted out of the dial upon the ascent of the tool is clearly shown in the halftone. The end of the punch or square broach is left slightly larger than the remainder of the tool. It will be noticed that the press is equipped with the spring-controlled pawl-slide for indexing the feed dial and the safety stop which have already been illustrated in connection with this company's presses.

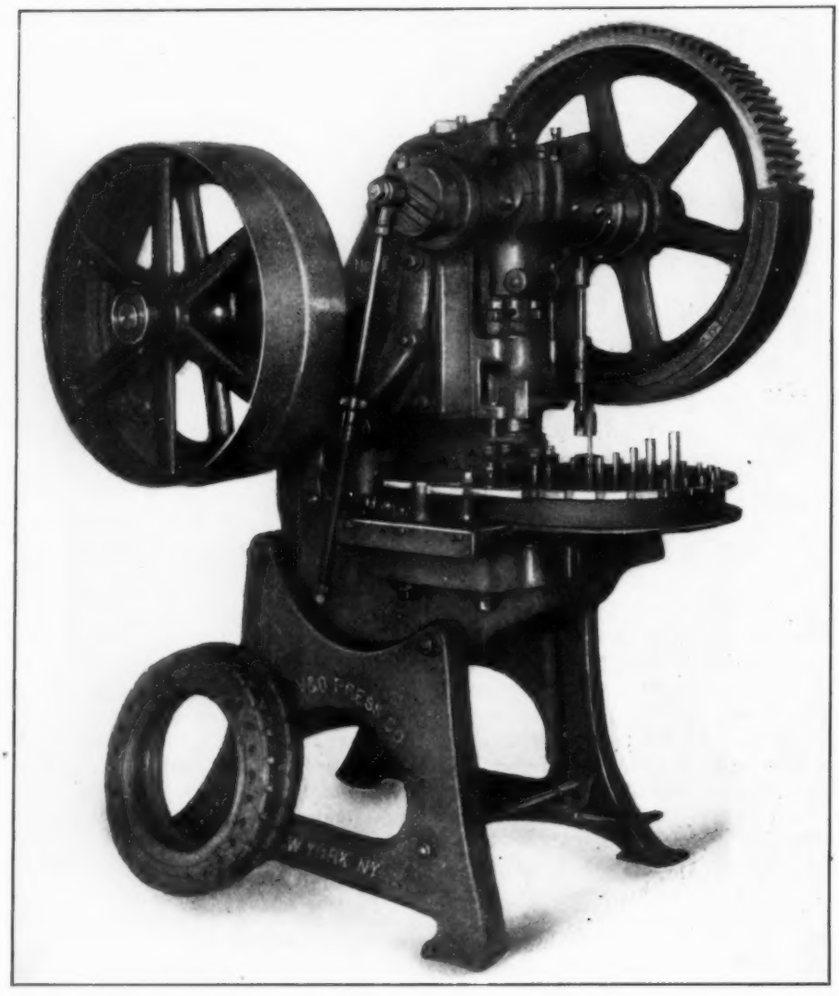


FIG. 1. V. & O. PRESS EQUIPPED FOR BROACHING SQUARE HOLES IN CHUCK SCREW BLANKS

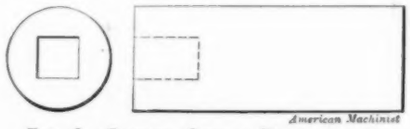


FIG. 2. CHUCK SCREW BLANK WITH SQUARE HOLE IN END

Centering Fillets

BY EDWARD M. WISE

I would like to call your attention to a little device which I made for putting radii and fillets in drawings, and assisting in the location of their centers.

It consists of a piece of transparent celluloid about 1/64 inch thick and 6 inches square, upon which have been scratched with a pair of sharp dividers, circles from 1/16-inch radius up to one-inch radius, advancing by thirty-seconds. A soft pencil can then be rubbed over these scratches so that they can be readily seen. The centers of the circles are punched completely through the celluloid. The circle of the desired radius can be fitted to any two diverging lines, the center marked on the drawing with the sharp point of the bow pen and the radius can then be drawn in very quickly. This is especially useful in drawing radii in angles other than right angles.

In locating centers of existing arcs or circles, the celluloid is placed on the drawing until the circles or arcs coincide and the center is then marked. This is especially useful in tracing when the center has become lost.

Letters from Practical Men

Dies for Making Seat Rails for Steel Chairs

Concerning the details of making things in machine shops, from the first sketch to the shipping room.

A letter good enough to print is good enough to pay for. The value is in the idea—not the length of the letter.

The sketches illustrate tools for making seat rails for steel chairs, which I saw in a small shop where I worked some years ago. The main feature of this method is the use of a "dovetail" die by which it is possible to make a smooth and practically solid seat rail out of strip stock, thereby reducing waste of stock to a minimum.

A view of half a seat rail is shown in Fig. 1. These rails were, if my memory serves me correctly, about 12 inches diameter and were made from 1/16-inch bright, soft steel, which came in strips the correct width, about 1¾ inches.

The Dovetail Die

The "dovetail" die is shown in Fig. 2. The cast-steel die *A* is secured by screw and dowel, as shown, to the cast-iron die-holder *B*. The stripper *C*, of mild steel, is fastened to *B*, as shown, there being a slot milled in the underside ⅛ inch deep and wide enough to let the stock slide through. The stripper is extended and a hole worked through it a snug fit for the punch, so as to give the punch support and keep it up to the die when at work. It will be noted that the working end of the die overhangs the die-holder. This allows the parted stock to drop off the die.

The punch *D*, of cast steel, is fastened by screw to the mild steel punch-holder *E*, the tongue in the center serving in place of dowel pins. The punch is fitted parallel, fitting the stripper all the way up and is made a rather slack fit for the die, the reason for this being explained further on. The stop for this die, which is not shown, is merely a bar of mild steel, bolted to the bolster of the press and having a sliding piece or stop which can be adjusted to any length along the bar and clamped there. As these strips for a 12-inch diameter seat rail are a bit over 3 feet long it is obvious that a stop fastened to the die would be rather cumbersome.

How the Die Works

The operations with this die are as follows: The stop is inserted through the slot in the stripper until it slightly overlaps the working face of the die. The press is then tripped and the small piece cut off the end of the strip, leaving the end dovetailed to the shape of the die. The stock is then advanced to the stop and the press tripped again. This time a strip the required length is cut off, the end last cut being dovetailed the shape of the punch. This continues until the end of the strip is reached, each stroke of the press cutting off a strip, one end of which duplicates the die and the other end, the punch. The only waste from these strips are the two small pieces cut from each end of the long strips.

Bending and Joining the Strips

The strips are next run through rolls which bend them to the required circle. This brings the two ends of the strip together and it will be seen that the one end fits the other, the same as the punch fits the die. Of course, you can't push them together, but by having the punch a rather slack fit for the die, as mentioned before, this gives the sides of the dovetails a slight taper, equal to half the difference between the punch and the die. This taper coming on opposite sides of the strip, allows the two ends to be matched easily. They are then put on a plain horn die of the required radius, and the plain punch coming down forces the two dovetails into one another, making a good tight fit. We now have a plain cylinder or ring, 12 inches diameter by 1¾ inches deep.

The Forming Tools

The forming die is shown in Fig. 3. The die is of cast iron, with a hardened-steel ring fitted as shown. This ring is given the required radius and is finished as smooth and hard as possible. The punch *A* is of cast iron, with a hardened-steel disk attached to the face by screws, not shown. A hardened-steel pad *B* is

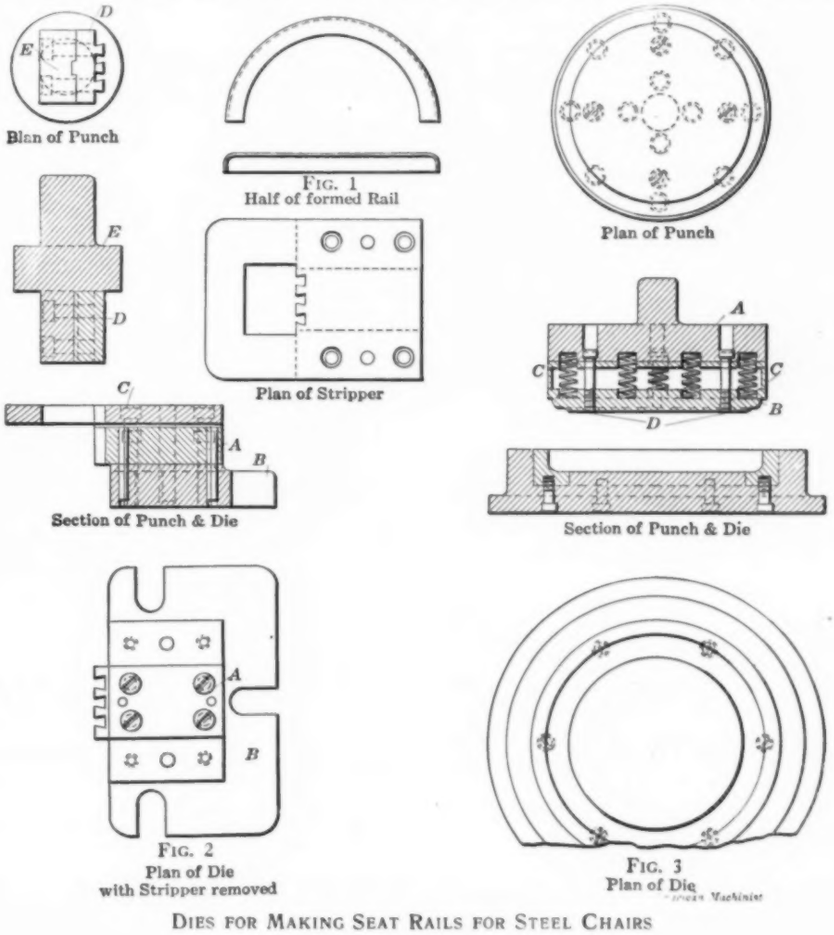


FIG. 1

FIG. 2

FIG. 3

DIES FOR MAKING SEAT RAILS FOR STEEL CHAIRS

also attached to the punch by four screws and there are 12 springs between it and the punch.

The action of this die is as follows. The rings or cylinders are slipped over the spring pad, up against the face of the punch, one being shown in position at *C*. The bottom edge of the ring *C* comes just to where the radius begins on the spring pad *B*. When the punch descends, the spring pad *B* strikes the bottom of the die and is firmly held there by the springs. There is just one thickness of the stock clearance all around between the pad *B* and the steel ring in the die and the punch continuing to descend, forces the metal down around and under the pad till it strikes the edge *D* and the punch strikes on pad *B*. As these surfaces are all hard and polished and well lubricated, the metal flows inward smoothly and coming hard between edge *D* and the steel face on the punch proper, when the punch grounds on the pad, the edges are left nice and square.

Advantages of the Method

As can readily be seen, when the ring is formed to the shape shown in Fig. 1, the dovetail joint is locked with no possibility of its coming apart and when the ring is polished, the joint can hardly be seen.

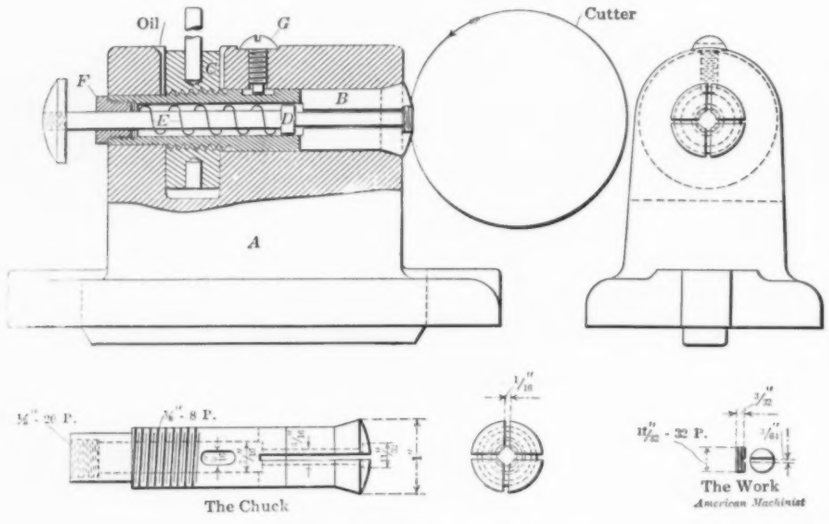
To my recollection there was some slight trouble in stripping these rings off the pad *B* after forming, the rings sometimes sticking fast, but this could easily be remedied by putting four or more spring fingers around the die at the proper hight, these being beveled on the upper face, so that when the punch descends it would push them back out of the way, and on the punch coming up, the springs would push them into the space between the punch and the pad *B* and so strip the rings off the pad. Of course, these fingers would have to work against a stop so that they couldn't spring in far enough to catch the pad *B* itself.

This method of making seat rails struck me as being first class; there was no waste of material, as when the rings are drawn up from the sheet and the center blanked out, and no rivets on lap joint. This method could also be applied to many other jobs of a like nature.

Liverpool, Eng. J. A. Hart.

A Simple Screw Slotting Fixture

While employed in a German shop we had to make a lot of screws, which were too short to be slotted in the ordinary way in the automatic screw machine. I made the fixture shown in the sketch for holding the screws for slotting and this did the work very satisfactorily at the rate of about 1500 screws in a day of ten hours.



A Simple Screw-slotting Fixture

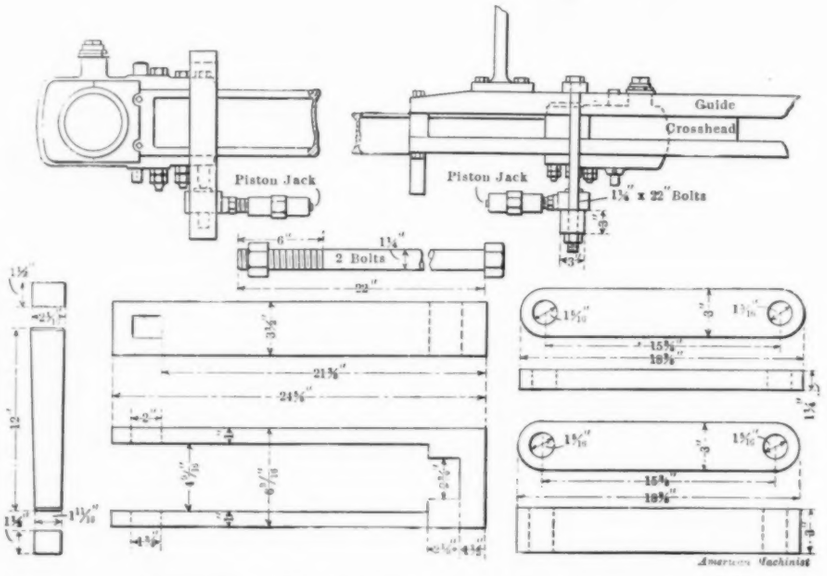
A is the cast-iron body, fitting the table of a Pratt & Whitney hand miller, bored and tapered at the front end to receive chuck *B*, which holds the work. The hardened nut *C* fitting the opening in the fixture moves *B* forward and back. *D* is a pin operated by spring *E*. *F* is a guide nut for *D*. *G* prevents the sleeve from turning when moved by nut *C*.

In operating, the screw to be slotted (shown at the lower right-hand corner of the drawing) is put in the mouth of chuck *B*, pushing pin *D* back, then *C* is rotated about one-fourth turn pulling the chuck back far enough to close the jaws and hold the screw firmly. The table of the machine is then moved toward the cutter against a stop, which gives the right depth to the slot. Now the table is moved back, *C* turned back to push *B* forward and allow the chuck to open and spring *E* pushes ejector *D* forward and throws the slotted screw out. If a screw should happen to stick, it can be removed by pushing *D* by hand.

Beverly, Mass. Chr. Burmester.

Removing Connecting Rod Bolts

This drawing shows a method of removing rod bolts with the hydraulic jack. It will remove any bolt that cannot be removed with the sledge hammer. It does no damage to the bolts and is very useful in the round house as it can be used at any position of the crank pin. The yoke shown is machine steel and is placed over the bolt to be removed. The key is then inserted in the keyway, a hydraulic jack placed on top of the key and when pressure is applied to the screw on



Apparatus for Removing Connecting-rod Bolts

the jack, the piston advances against the bottom of the bolt. The drawing also gives details of the apparatus.

W. J. SHADLE.

Shop foreman, Chicago & North Western Railway Company, Clinton, Iowa.

A Universal Lathe Tool

The common square-nose lathe tool illustrated in Fig. 1 is capable of more extensive use than is generally supposed. By many it is regarded as a finishing tool for cast-iron only, and not found at all in some shops. Therefore, its range of application may be surprising to those not acquainted with its use.

In practically all published data on speed and endurance tests, the round-nose tool has been used. This tool will not remove stock as readily, nor maintain its cutting edge as long as the square-nose, although the square-nose tool is much lighter in construction; that is, it has not the same amount of stock to support the cutting edge. The square-nose tool, however, works upon the principle laid down by James Hartness, in his work on the "Flat Turret Lathe." There is, therefore, no need to discuss this further.

Fig. 2 shows the square-nose tool roughing the outside diameter of the pinion blank. For some work a sufficiently accurate job may be made in one cut, the corner of the tool being flattened sufficiently to cover the lead so that a thread will not be cut. Fig. 3 shows the same tool facing one end of the blank, no change being made in this position; simply the other corner of the tool is used. In order to reach the back end of the blank, it would be necessary to set the tool from the opposite side.

Fig. 5 shows the same tool making a finishing cut on the outside diameter. It is well, however, to have another tool for this purpose, upon which a straight cutting edge is maintained, which is made the same form as the roughing tool. This tool is used on both the roughing and finishing cuts for both cast iron and steel. The angle of the cutting edge is varied to suit different grades of materials encountered. The clearance is made as small as possible in all cases, generally 2 or 3 degrees.

For turning flywheels, gear blanks, etc., this tool is especially useful. The blanks may not only be finished all over with the same tool, but the corners on the inside of the rim and outside of hub may be straightened up at the same setting. To witness the use of this tool on a boring mill by a skillful operator would be much more impressive than this description of its use.

New York. CHARLES H. LOGUE.

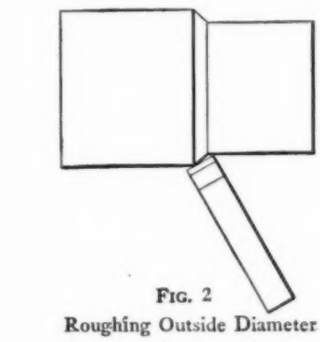


FIG. 2
Roughing Outside Diameter

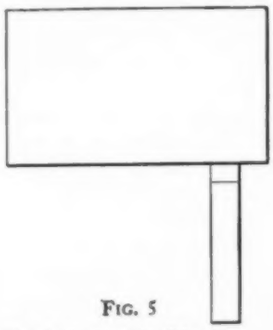


FIG. 5
Finishing Outside Diameter

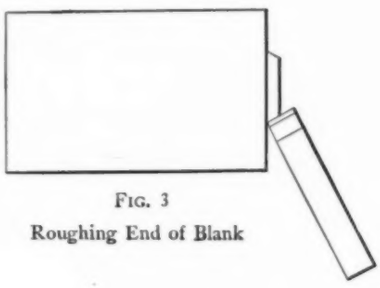


FIG. 3
Roughing End of Blank

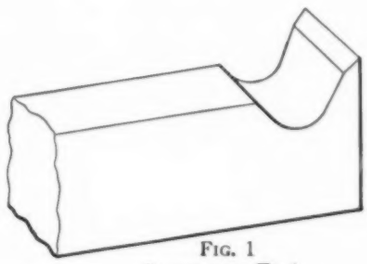


FIG. 1
Square-nose Tool

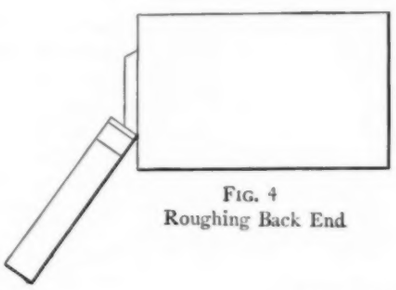


FIG. 4
Roughing Back End

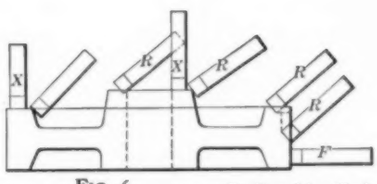
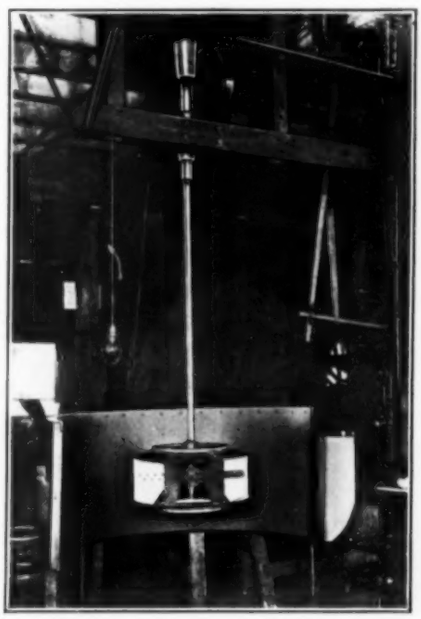


FIG. 6
Machining a Fly Wheel
R = Roughing Tool
F = Finishing Tool
American Machinist

A UNIVERSAL LATHE TOOL

A Vertical Balancing Machine

The accompanying cut illustrates a machine used at the works of the American Blower Company, Detroit, Mich., to balance their smaller size blower wheels. The wheel is balanced at a speed to which it is to operate, the variations in speeds being obtained by means of the friction drive shown in the upper part of illustration. The vertical shaft is tapered toward the top. Connection is made to the mandrel carrying the blower wheel by means of a universal joint.



VERTICAL BALANCING MACHINE

It is evident that a wheel but slightly out of balance will cause a noticeable vibration of the vertical shaft that can be readily detected. The wheel is then weighted until all vibration disappears. It has been found that it is absolutely necessary to balance high-speed blowers at their running speed, as the usual static or standing balance will not produce a true running wheel; the center of gravity not always being the center of mass.

Pittsburg, Penn. C. C. HOWE.

Anchor Holes For Babbitted Bearings

I do not claim the following ideas to be of my own invention, but give them as being good ones that are not used as frequently as their merit deserves.

In designing bearings that are to be filled with babbitt it is a common custom to make them with cored recesses and pieces cast on the top and ends of the box to hold the babbitt in place, as in Fig. 1, making it necessary to use loose pieces on the pattern at *A* and *B*, and loose core prints for the recesses *C*, as indicated by the dotted lines.

These loose pieces are of necessity of small section and, therefore, easily lost or broken, causing endless expense in the pattern shop to replace them. Sometimes castings will be received without any anchor holes in them, and the work has to bear the expense of drilling holes

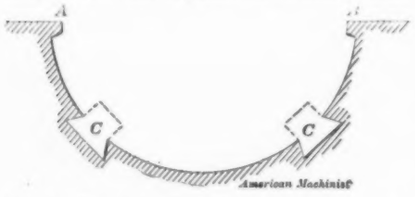


FIG. 1. BEARING REQUIRING LOOSE PIECES IN PATTERN AND CORE BOX

for holding the babbitt in place. I know some firms who do this always, for want of a little thought. Frequently, however, this is due to the draftsman neglecting to show these cores, either through carelessness or laziness.

I use plain round cores of the dimensions and shape shown in Fig. 2, and have the three sizes for the different sizes of bearings. These cores are made up on stock in the coremaker's spare time, and have been christened by the name of "buttons," which they strongly resemble. They are simply fastened onto the core or mold, as the case may be, with one nail each, and as many can be put on a bearing as may be thought necessary. They require no core prints, either loose or otherwise. It has been found, however, advisable to paint circles on the pattern the same color as is used for core prints, in the position where it is desired these buttons should be placed, thus giving the molder the number and size of button to be used and serving as a constant reminder to him to use them.

Writing so much about loose pieces brings to my mind some other places where they could be avoided more often than they are. Take as an instance the small bearing in Fig. 3, as usually made, the boss on both sides has to be loose in the pattern or a core made to fill up the space between the dotted lines, shown sectioned in the figure, while by filling in this space solid as in Fig. 4, the pattern can be made solid, and save the molder's time that would otherwise be spent in drawing out of the sand these loose parts, the cost of which will greatly outweigh the few ounces of cast iron added to the bearing.

A further economy that can be made by a little forethought is the use of angle sections instead of T-sections, where possible. In getting out designs for legs, stands, brackets, etc., it is a common fault to make them T-section, as in Fig. 5, necessitating making the pattern in two parts, with the parting at *A B*, adding extra cost to the pattern work, and having the parts at *C* very thin and easily broken, whereas by making it as in Fig. 6, the pattern is all in one piece, with no very thin places, and altogether will stand twice as much of the molder's playful knocks. The latter style is obviously cheaper, both in pattern work and molding and in most cases equally as good as the first.

J. S. WATTS.

New Glasgow, Canada.

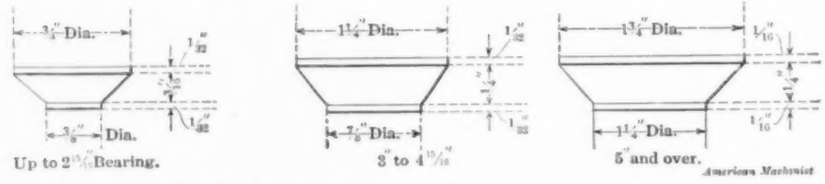


FIG. 2. ANCHOR CORES FOR BABBITTED BEARINGS

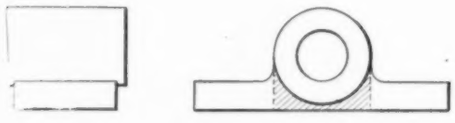


FIG. 3. BEARING REQUIRING LOOSE PIECES ON PATTERN

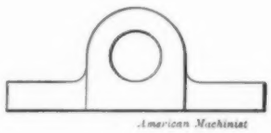


FIG. 4. BEARING REQUIRING NO LOOSE PIECES ON PATTERN

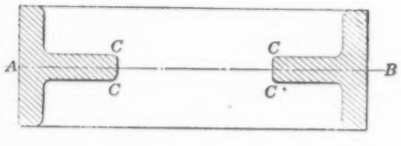


FIG. 5. SECTION REQUIRING PARTED PATTERN

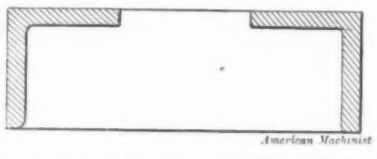
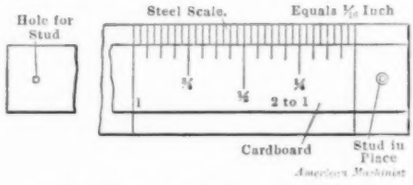


FIG. 6. SECTION REQUIRING ONLY ONE PIECE PATTERN

Attachment for Draftsmen's Scales

The sketch illustrates one of a set of scales to be used in connection with the well known Starrett steel draftsman's scales, whereby their field of usefulness may be greatly extended when it is desired to lay out drawings over or under size.



ATTACHMENT FOR DRAFTSMAN'S SCALES

These extra scales are made from thin bristol board, about 5/8 inch wide, ruled with the desired graduations, and painted with white shellac, which protects them from injury in handling.

The one illustrated is for drawings 2 to 1, or double size. The side shown is graduated for fractional dimensions, and the reverse for decimals. It is not necessary to mark the finer graduations on the cardboard, as it is placed so that the edge does not come to within about 3/16 inch of the edge of the steel scale, and the etched lines on the latter may be used for pointing off. Sixteen divisions per inch on the fractional side of the scale illustrated, and twenty per inch for the decimal side are sufficient. For the 4 to 1 scale, eight and ten divisions per inch are enough.

The cardboard scales are attached to the steel scale by means of the studs on the latter, through two small holes provided for this purpose.

A set of these scales comprising 2, 4, 5, 8 and 10 to 1, I have found to be very useful for small parts which have to be drawn to large scale, as they save much multiplication of figures and reduce the liability to mistakes. One-half and one-quarter-to-one scales are also useful for drawings to reduced scale.

T. J. S. KISHPAUGH.

Harrisburg, Penn.

Discussion of Previous Question

Design of Ball Thrust Bearings

At page 651, Part 1, of the current volume, your correspondent, Gustaf Rennerfelt, advances certain figures in reference to self-alining or self-seating bearings, that, to put it mildly, are somewhat startling. Assuming a load of 1000 pounds upon a particular bearing, he states that it is possible for a difference of no less than 600 pounds to exist between the loads carried by the balls or opposite sides of the bearing, 800 pounds being carried at one side and 200 pounds at the other.

The results arrived at, in themselves, should have been sufficient to prove their erroneous character, otherwise designers would be simply courting failure in using bearings of this description, since if it is possible for this difference to exist on account of the nature of the bearing, it is almost impossible for it not to exist. In other words, to insure an even distribution of the load it would be essential that the race with the spherical seating should be set exactly at right angles to the direction of the load in the first instance; not approximately, but exactly at right angles, and that this setting should not be disturbed by subsequent operations.

As it is impossible for these conditions to be assured in ordinary practice, it follows that there would always be this difference between the loadings of the opposite sides, so that instead of being an improvement on the ordinary flat seated kind, this type of bearing would be really much inferior, provided the former were well made and properly fitted.

An illustration, drawn from an actual case in hard figures may bring the meaning of this home more forcibly. A bearing having eight balls, one inch diameter, has a safe working load, according to the makers' catalogs, of 25,300 pounds. Dividing this figure by the number of balls, gives 3162.5 pounds as the maximum safe load per ball. For the purpose of this argument, it may be assumed that twice this amount, viz., 6325 pounds, will be carried by any two balls at opposite sides of the bearing. Taking up now our friend Rennerfelt's formula, we get a loading on one side of 5060 pounds and at the other side of 1265 pounds, so that as the bearing revolves, each ball will be subjected to a load continually varying between these amounts.

It is perfectly obvious that the balls in a correctly designed bearing will not sustain a load of this character which continually alternates between an overload of 60 per cent. and down to only 40 per cent. of the designed load, since it is well known that an intermittent load is much more destructive than a steady overload of the same amount. It behooves us, therefore, to examine the formula to see where the error lies. This is not difficult to discover, for, for the purposes of his calculation your correspondent assumes 0.2 as a suitable coefficient of friction, but does not state his authority for this figure.

One of the earliest investigators in this line of research, Morin, who carried out experiments to discover the coëfficient of friction between various kinds of metal, gives for lubricated surfaces of metal from 0.07 to 0.08, as the coëfficient at low speeds. This is perhaps the nearest approximation to the case under discussion, that we shall be able to find out and if substituted in the formula for the figure used, will give as a possible distribution of loading in this bearing; 3826.5 pounds and 2498.5 pounds for the opposite sides.

Having regard to the nature of the case, however, it is almost certain that even this figure would be very considerably reduced. Morin's figures are admittedly high and the vibration produced by the rotation of the bearing would also have the effect of reducing the coëfficient, making the bearing much more lively in this respect than any figures that could be advanced would show.

Of course it is not maintained that a bearing of this description will so accommodate itself to the direction of the load that every ball will carry an exactly similar amount; there must of necessity be some difference between the respective loadings of the opposite sides, and a useful purpose will have been served if this is realized by designers and users of ball bearings. At the same time a great injustice would have been committed if such an extreme article were allowed to pass by default, particularly as anything published in the AMERICAN MACHINIST carries a certain weight from that very fact.

Your correspondent also says that bearings "are worn to a groove that is much deeper on one side than the other." If there is a groove worn all around the bearing, it conclusively proves that the bearing has not been overloaded, but simply ground out by grit or foreign matter being allowed to get onto the races. An overloaded bearing fails in spots or patches, and is then speedily destroyed.

Coventry, Eng. H. P. WOOD.

Letters from our readers showing how many men of many minds look upon various subjects opened up in previous numbers.

Drawing Room System—Up-to Date Prints

In reading the various articles on drawing-room systems, it is interesting to note the very clever manner in which the many vital points are handled, but the one point where we all "get up against it," is the point well covered by Mr. Harris on page 560, namely; how to be absolutely certain that each department has the very latest print.

This is such a vital question for both shop and office that the following method, which I saw in use in a very large concern, may be of interest.

For many years they have built a varied and extensive line of machinery, with the attending improvements and developments, which require careful records in order to supply repair parts; and of course new machines coming through must not be mixed up with the older drawings. A point was lately reached where something had to be done, so after much investigation, a very complete system for drawings was installed. I will not describe this now, but among the many good points was the placing of all parts on small standard-size sheets, one part on a sheet. There are many thousands of these sheets, filed in neat cabinets, and with each tracing are placed two prints ready for use.

The order clerk makes out the shop order tickets, a ticket for each part and when ready, they go to the drawing office. The clerk here, takes a ticket, which of course, has the part number on it, turns to the file and removes the tracing and one print. The tracing is dropped into a box and the blueprint-room men know that one print is needed for the file. The clerk pins the prints to the order ticket, steps to the perforating machine and perforates the order number through ticket and print. The print cannot be used on any other order number but it is attached to the order ticket and when order is completed both must reach the cost clerk, who finds time and material entered upon the back of the ticket.

In this way only one place is responsible for prints, and shop foremen do not

spend valuable time hunting through files of ancient prints for a rather uncertain "print we used to have," for he gets the print with the order. A workman cannot pick up the wrong print, for the shop system allows him only one order at a time.

As prints are used only once, it may be thought that the cost of blueprints will be a bad feature, but as the drawings are only 5x9 inches, the print will not cost more than 3 cents, and many prints can be made for what it often costs when work is done from an obsolete print.

Rochester, N. Y. RALPH W. DAVIS.

Transmission of Power by Belts

I was much interested in Transmission of Power by Belts, on page 969, Part 1, Volume 33. This use of thin steel is certainly novel, but why not braze the joint the same as is done with band saws?

But what excited my curiosity was that someone in France has "invented" a belt drive which includes a "jockey" pulley. (I have always heard them called "tighteners"). Fig. 3 was a cut showing the "usual location of the jockey," which I never have seen in practice located on the tight side of belt, except where it was necessary to carry the belt overhead or out of the way, and to call this device of Captain Leneveu an invention seems very absurd to me. I made one in the year 1875 and have used many since then. It usually happens that the driver is the large pulley and so the tightener frame is hung on the driven shaft, each side of the driven pulley.

From time immemorial (almost) the tightener has been used in sawmills, and today it is unusual to find a belt in a sawmill, unprovided with a tightener, though the millwrights usually hang or hinge the tightner frames from an independent support and not on the shaft. One advantage of hanging it on the shaft is that when the jockey is once adjusted to lead the belt correctly on the driven pulley it will continue to do so until the journals are worn so much as to throw the shafts out of line.

Oshkosh, Wis. E. S. NEWTON.

The Narrow Guide in Machine Tools

I was interested to see C. H. Hill's letter on page 889, Part 1, Volume 33, respecting the narrow-guiding principle. With regard to his first paragraph, I do not agree that the fact of the guiding surface being so near to the screw is any more important than the effect of the long narrow guide in reducing twist of the saddle, apart from any consideration of propelling. I attempted to show with my T-square illustration the great resistance which the outer end of a saddle so guided will offer to lateral thrust. I have always been struck, when using a T-square, with this rigidity of the blade, though only held lightly with the hand against the edge of the board. Mr. Hill seems to have misunderstood the idea of the sketch, when, in the beginning of his second paragraph, he speaks of the absurdity of attempting to move the square by the outer edge of the blade. This, as I state above, is intended to show the resistance to twisting, and is on precisely the same principle as the side-planer saddle in Fig. 10 of my article at page 346, the outer end of the T-square being equivalent to the end of the arm which carries the tool box, where the thrust is received.

I am aware that there are parallels with two guiding heads, situated at the opposite ends of a long blade, but the strain tending to twist these is practically nil, and the illustration does not bear comparison with the case of a lathe saddle. Otherwise, if Mr. Hill's contention were correct, it would be quite proper to have extremely short guiding edges on a lathe saddle spanning over a wide bed; this is, of course, quite contrary to practice.

I would point out, moreover, that lathe makers have repeatedly urged, and are still urging upon purchasers the fact that their saddle or carriages have "extra bearing length" on the bed. Yet what is this but a step toward the long narrow guide, of which the examples given in my article are simply abnormal developments, and yet quite reasonable and logical ones?

Mr. Hill says that a great deal of machine-tool design at the present time appears to be dictated by fashion rather than from a point of practical utility. In applying this remark to the case in point, I am afraid that he does machine-tool makers an injustice. Competition is too keen nowadays for any firms to continue using constructions which do not yield marked advantages. If a thing is found to be of no real use, it is quickly dropped. The fact that several leading firms have employed the narrow guide for years, and that many others are following their example, certainly does not seem to indicate that the construction is of no particular advantage over previous forms. There are a good many other examples besides those which I selected for illustration.

Mr. Hill thinks that the correct location of the propelling force is *the* question. Now, there is no difficulty in placing the propelling force in the correct location, in for example the Richards' side-planer saddle, and the cutter slide of a gear cutter; that is, in the center, midway between the two shears. Yet this very construction has been abandoned by Messrs. Richards for their side planers in favor of the narrow guide on one shear only, and by several leading gear-cutter makers, also in favor of a single-shear guide. I believe that I am correct in stating that firms favor the narrow guide in these instances chiefly because of its effects in minimizing the twist of the slides.

With reference to the question whether "excessive length to width" is better than the "ordinary moderate proportions which have been in use, and proved satisfactory for so long a time," in Mr. Hill's third paragraph, I would point out that many details of machine-tool construction, which have proved satisfactory for a long time past, do not now meet modern requirements, on account of the introduction of high-speed steels. The strains are so greatly increased that many parts that acted perfectly under the old conditions, have had to be modified to enable them to withstand the new conditions.

In regard to the reference to Professor Nicolson, I am afraid that no expression of opinion, apart from practice, on the merits or demerits of any construction will influence work-shop methods.

I cannot see that the narrow guide involves any more expense or trouble to fit than edges embracing a wide bed, and from the point of durability, and retention of accuracy, experience shows that it is in no way inferior to guides of the ordinary kind.

Bath, England. FRED HORNER.

Designing Dies Economically

The sketch shows how considerably more metal can be saved in laying out

DESIGNING DIES ECONOMICALLY

dies than is possible with Guido Sacerdote's arrangement, at *B*, Fig. 2, of his article on page 1098, Part 1. This may be accomplished by turning the metal or making a triple punch and die.

Hartford, Conn. M. O. DEAN.

The Apprenticeship Question

Having read at various times of the different schemes propounded by American mechanics for the efficient training of the young apprentice, I thought it would be of interest to describe briefly a method adopted by a large firm in London and which one can confidently assert, has been successful for a number of years. Realizing that every boy who aspires to become a mechanic has before him a lengthy period of real hard work, both in the shop and at the school, they started to handle the question by sorting out the "probables," or those who showed some aptness for grasping a serious proposition, by making the rule that only boys who could pass an examination of a certain standard were eligible for entry as apprentices.

By this means a good class of lad was introduced, at least they were sufficiently intelligent that it was possible to start straight away and begin to teach them a trade.

When the boys arrived in the shop they were put directly under the supervision of a reliable mechanic, who by reason of having the responsibility, was paid extra wages. By these means of remuneration, it soon became apparent that the mechanic was glad to have the apprentice with him and naturally took a keen interest in his welfare. The boy also profited by having the individual tuition of one who had previously been through his facings, one who knows how to smooth the path of the inexperienced learner and initiate him into the mysteries of a mechanic's life.

The lad would generally start on the lathe, where he would remain a year or two, then he would be put on the planer, drill press and miller and would finally wind up in the drafting room for a short period.

Meanwhile his studies were being well looked after at the Polytechnic and it depended equally on his advance in this direction and the energy he infused into his class work as to the promotion he got in the work shop.

He was told off to take up an engineering course, the subjects of which were planned out for him by the employer; they were, of course, subjects bearing essentially on his work and divided up into first-year to fifth-year courses.

The time spent at the class was chiefly scheduled out as follows: Five hours per week for which he was paid, these hours were included in his working time, and two hours of an evening for three evenings per week.

Thus it will be seen he spent, weekly, 11 hours at the school and 43 hours at the shop, which was a very equitable arrangement.

It was necessary for him to gain a percentage of at least 50 in the term examinations of which there were two per year for the first three years; this was necessary for him to retain his apprenticeship. He has no school fees to pay and all technical books were supplied for his use.

Thus you will see a lad had to apply himself diligently to his work or become a failure, and such cases were very few. A larger percentage of boys are the sons of artisans and in the first instance drawn from elementary schools.

It seems one of the chief things to get an apprentice to realize the seriousness of his position, the years to be spent serving his time means everything for his future and although he may be nursed in the old shop, he has to look forward to the time when it is necessary to go out into the world and earn his livelihood in the walk of life he has chosen, with the sterner feeling that he has got to do as well as the next man to him or the "boss" will not be requiring his services.

With the steady advance of the standard of work turned out of our engineering shops today, the keen competition and the consequent speeding up he will find he is left out in the cold with the old-time, rule-of-thumb fitter, who in a few years will be known to memory only.

London, Eng. L. A. GEORGE.

Rolling Threads in a Turret Lathe

I have read with interest the article on thread rolling, by Sam Kinsey, Jr., at page 931, Part 1, and having had a good deal of experience with this method on both steel and brass work, I wish to mention a few points, which may be useful to some of your readers.

The following results have been arrived at after a good deal of careful experimenting:

It was found impossible to fix on one formula for finding the diameter of the roll without taking into consideration the kind and quality of metal to be threaded owing to the varying density and plasticity. The action of rolling the thread causes the metal to be displaced and "rolled up" in places and this necessitates the work being made a special diameter before rolling, to give the best results.

The roll gives better satisfaction if run either underneath or over the work, over for preference, as it is then clear of chips from the cut of the tool, with an arrangement for adjusting for hight. This allows both form and cut-off tools to be carried on the cross slide, the cut-off tool being used in a special holder which also carries the roll in advance and is arranged so that the roll is clear of the work before the cut-off tool begins operations.

Small fine threads are apt to strip. This is caused by the roll, after passing the center of the work, not having sufficient friction to drive it around and stopping before it is quite clear of the threads. Therefore, it is best to stop the spindle in a position where the roll is just past the center of the work and until it is clear of the threads. Using the above methods, thread rolling gives good results on full- as well as semi-automatics. A good illustration is the production of the bodies of sparking plugs in one operation.

A good supply of lubricant should be used. For rolling right-hand threads the roll should be cut left-hand, and *vice versa*.

London, Eng. EDWARD HAMILTON.

The article under this heading, appearing on page 931, Part 1, treats of a subject about which very little is written, and if it stimulates an exchange of opinions between those interested, it will not have been written in vain.

Referring to the items below the sketch of the work in Mr. Kinsey's article it will be seen that:

A = Outside diameter of work.
B = Pitch diameter of work = A-½ constant.

But A-B = Depth of thread so that the constant taken appears to be twice the depth of thread, in which case the formula will read: The outside diameter of roller = twice the pitch diameter of the work + the depth of thread, with leads as 2:1.

Some time ago several thread-rolling jobs came under my notice and the above was the first formula evolved for the diameter of the roller. The threads were in brass and varied in diameter from 5/16 inch up to 1 inch × 26 threads; but in all cases the work rolled up too large in diameter. This was not to be overcome by forming down the work, previous to rolling, because any attempt in this direction simply resulted in a stripped thread on the work. A slight variation in the finished diameter of the work was obtainable by this method but was not enough to secure the diameter of thread for which the roller was made.

New rollers were then made, the outside diameter being decreased by an amount equal to the excess in the diameter of rolled thread × $\frac{\text{diameter of roller}}{\text{diameter of rolled thread}}$ and these gave very satisfactory results. These operations were all carried out on an automatic screw machine, the roller being carried in a holder having vertical adjustment on the back tool post, allowing the roller to pass underneath the work. As soon as the roller was quite clear of the work, the cutoff tool was just in position for commencing cutting, so that both operations were performed with the one stroke of the cross slide.

In the case of steel samples the formula was more at fault than on the brass

ones, the excess in diameter over that aimed for being much more pronounced. The sizes of these varied from ¾ inch × 16 threads up to 2 7/16 inches × 24 threads.

When forming down the work ready for rolling, the steel samples had to be reduced in diameter an amount equal to the depth of thread; but in the case of brass the reduction was less, being barely ⅞ the thread depth. This difference is no doubt accounted for by the fact that the brass being soft is compressed somewhat during the process of rolling out the metal from the bottom of the thread and transferring it to the apex.

The rollers should not be made too hard on account of the liability to chip the threads; and in order to prevent the roller picking up on its spindle due to the pressure, it is advisable to fit them with a hardened bush.

In all cases the roller should be threaded the opposite hand to that required on the work.

Liverpool, England. F. O. HALL.

Experimental Work in the Small Shop

The editorial "Experimental Work in the Small Shop," on page 937, Volume 32, Part 1, is a timely word on what in many cases tends to become a distinct evil. Experimenting is a proper and necessary thing in all shops, either in the form of perfecting methods of production, of reducing cost of production, or the introduction of new features which will render the shop product better and more salable. Experimenting, however, has a fascination; and where it is not under proper control, but is conducted on a sort of hit-or-miss principle, it is undoubtedly a wasteful item of expenditure and makes havoc in many a shop. All new ideas ought to come before some party or parties capable to report on them and capable of giving an impartial judgment. Too often I have seen time and money wasted on some idea which seemed to be quite reasonable at first sight, which, however, had it received the maturer judgment of capable men would never have been gone on with.

Quite recently on this side, there was a shop, and not a very small one either, brought nearly to ruin through the extravagance of the managing director. He was a man of ideas; the company had been formed to manufacture one of them, but he sadly lacked balance and judgment. Under his direction expensive jigs and fixtures would be made, only in a short time to be consigned to the scrap heap. Tools would be readily bought, only to be as readily cast aside, and men would be started to get out some idea of his which very often proved to be of no value and the men knew it before they started the job.

I have often heard it stated, and have myself proved the truth of the statement that the most difficult man to convince that an idea or invention is of no practical value is the inventor himself. We are all apt to think too much of our own children; we see their many good points and I am afraid too often we put their drawbacks and failures to one side, with the remark that they are but details and it will come out all right.

AN EXPERIENCE WITH AN INVENTOR

From my own experience as a foreman in a shop where suggestions are encouraged and where any idea, if found practical and proves an advantage, is well paid for, I have sometimes found it difficult to convince men who fancy they have an idea for some improvement, but which in the opinion of those qualified to judge is of no practical value. They seem to think that their ideas are not wanted and I have heard the remark made that it would be a long time before the management would again get the chance to refuse their suggestions. Not very long ago we had a case in point. One of our machinists was an exceptionally smart young fellow, full of ideas, and who thought a lot of them, but whose failures had not had the desirable effect of maturing his judgment and making him very careful before he trotted out anything new. One day he came to me with all the marks of excitement about him. He said he had invented an automatic machine that would displace all the semi-automatics we had engaged on a particular part of our work. He was going to patent his invention as he thought his employers might take an unfair advantage of him if he did not. I advised him not to and told him from my experience of the firm, that if his machine was worth anything at all it would be adopted and he would be well enough paid for it. He said he would think it over, and some days later he let me know that he would like to put his idea before his employers. He had an interview with the managing director and told him his story; he had invented an automatic machine and he believed that with some alterations his mechanism could be fitted to our existing semi-automatics. He had made a full set of drawings and was convinced it would work. These drawings, however, he would not show, neither would he go into details unless some agreement was drawn up; he was prepared to accept so much per machine if successful, and did not expect anything if the machine should turn out a frost. The position was this: The firm were to sign an agreement before even having an idea of the machine; then they were to stand the expense of experimenting upon one of their own semi-automatics. From this position our inventive friend would not move. Ultimately he was told to send in an estimate showing the probable cost of altering a machine, the number of machines a man could operate, and the number of pieces he would expect to turn out per day, and the whole matter would be looked into and reported on. This he did and his estimate was very carefully gone into and compared with the cost of the product of the semi-automatic.

The result came out as follows: If his machine would do all he claimed for it, which we doubted, then one man, assisted by a boy might take the place of two men and the output might be increased by about 10 per cent. Against these merits we had to place the following demerits: The cost of the alteration was fairly high, an increase in toolmaking would be necessary, toolsetting would be more difficult, and on the whole it would be a machine much more complicated than the simple ones in use. In view of the above, and the attitude of the inventor, it was decided not to make the experiment, this decision also being influenced by our former experience with an automatic bought from a prominent American firm. Needless to say, the inventor was not pleased, he did not patent his invention, but to this day I am afraid he thinks he was not fairly dealt with.

T. K. POWRIE.

Glasgow, Scotland.

The Process of Invention

First, scheme out all the different ways of accomplishing the required ends that it is possible to think out. Next, study each scheme thus developed, and find the poor points thereof. In fact, "Kill that scheme" if possible. If it cannot be "killed" it is likely to be good for something.

Next, study the mechanical problems in each scheme or method and determine therefrom, the relative value of each method to effect the desired ends. Next, work out the comparative cost of each method, and while about it, determine as closely as possible, the cost of working by each scheme after it has been put in operation. To be sure, there is lots of guess work involved in things of this kind, but it is surprising how closely a man can arrive at the actual costs and characteristics of the various methods which have presented themselves; and by the time they have been all sifted down by the methods noted above, it is safe to say that the best one among them—if indeed there be any *best*—will have been discovered, and may be "nailed" for the one which is *the* method that is wanted.

The above method proves a sort of cross roads, and forms a veritable "short-cut" for the busy man who has to work out hundreds of devices, methods, operations. It enables him to eliminate the most glaringly undesirable with a minimum of time and energy. Try it once, and you'll never let it get away from you.

Prevention of Industrial Accidents

By Frederick R. Hutton*

Industrial accidents from the standpoint of the mechanical engineer.

The advantages of continuous production in any shop or factory.

Industrial accidents defined and the New York classification of extra hazardous occupations.

The human factor in accident cases depends on the worker's physical and mental condition in all cases where all dangers cannot be safeguarded.

*Past president and honorary secretary of the American Society of Mechanical Engineers; chairman of committee on Plan and Scope of American Museum of Safety in New York.

The one ideal which a works, or shop manager sets before him as his goal of success is that the processes of production on his plant shall never be arrested. The interest charge, the overhead factor or burden, depreciation, insurance and the like run on day and night. The production processes which are to pay these charges must equally be continuous. If production and sales could be conducted on a 24-hour basis as efficiently in three shifts each of eight hours, the manager could proportionately lower his overhead or burden rate, and lower his price or increase his profit, as compared to conditions when production is intermittent. The major premise of the argument of production is its processes should be continuous.

What is an industrial accident? An accident in its broad and general sense is a something which "falls in or upon" the normal working of any set of forces. It is something which happens, and is out of the ordinary course of procedure. A true accident has in it the quality of the unexpected. Death, for example, is not an accident of the human life, but its premature coming by violence or mishap is one. As soon as any event becomes predicable and sure to come, it ceases to be an accident. For example, a man may have something befall him as out of a clear sky which he could not foresee. He has met with an accident; he is to be sympathized with, not to be blamed. If the same man has the same thing happen to him a second time, he is unfortunate, he is to be pitied, but he should have taken precautions in the light of his first mishap. If the same thing happens to him the third time or oftener, he is a fool, and nothing would teach him. On the railway the collision, the derailment, the broken axle or connecting rod are accidents, because they are not normal, and in time with proper design and apparatus will disappear.

An *industrial* accident is one which happens in a shop or plant engaged in production. Such a plant has motive power, transmission apparatus to distribute such power, machines designed to do work on the raw material, and human factors directing, controlling and operating the machinery. Its normal march is the steady and uninterrupted procedure of the production. An accident is a something which falls in to arrest such steady production. If possible, by the first contention above, such accident is to be prevented.

The raw material and the idle machinery of the plant in equilibrium cannot be the occasion of an accident. The happening must be the result of a force, or the disturbance of an equilibrium of forces. Hence in such a plant the accident comes either through the motor energy which drives it, or from the energy or initiative of the human factors; or in the third place from the liberation or destruction of balance of forces normally in restraint. Fires, explosions and injuries to and from falling bodies are in this third class. The common accident in industry is from the first two sets of causes. It is plain, therefore, that the matter of preventing industrial accidents is the engineer's job, and that of the mechanical engineer in particular. He is the designer of the machinery, motive-power transmission and tools. He controls the mechanical forces at work throughout. But under modern American conditions he is also the controller and director of the human factors, as manager or superintendent or specialist in production. He cannot, therefore, escape his responsibility, and the propriety of making the owner and his educated and competent representatives the responsible parties to bear the cost of preventable accidents begins to appear, as under the English law of 1897 and the New York State law of 1910.

This law recognizes eight avocations in industry as being notoriously dangerous to the worker. All but one are in the third class of the foregoing analysis. These are:

1. Erection and demolition of buildings.
2. Operation of hoisting machinery, cranes, elevators and the like.
3. Work on scaffolds over 20 feet in the air.
4. Work on tunnels or subways.
5. Work under compressed air.
6. Work on apparatus charged with electric currents.
7. Work in or near explosives, dynamite and powder.
8. Railway operation and repair, with any motive power.

The danger in all these is clearly from the magnitude of the forces in check or control by other forces, and where any disturbance of such balance occurs and gravity can act uncontrolled, the human unit is swept to destruction. The work under compressed air is also dangerous to many men. Outside of the range of these eight are the far broader fields of industry where the force injury to the worker comes from the motive power he uses and controls in his machine. Here, therefore, the industrial accident may be one of three kinds:

1. An accident to the machine which does not affect the worker.
2. An accident to the worker which does not affect the machine.
3. An accident to the machine which involves the worker, or to the worker which involves the machine, this being a combination of Nos. 1 and 2.

Under ideal conditions in the future, when knowledge of properties of materials has become complete, and the designer also knows all possible stresses to which the machine elements are to be put, the machines of the factory will be so designed and made that under normal handling they shall never break down or fail. If there is such a thing as fatigue of metal under repeated stresses, it will be known how many million shocks the machine will stand and it will be relieved from service in time. The conscientious fidelity of the man who assembled the machine and the man who uses it must also be assumed here. But even under such ideal conditions for design and use, the material may develop a defect in use which even the best inspection cannot detect, and, of course, the operator may unwittingly expose the machine to stresses far beyond those for which it was designed. Speaking generally, however, it may be safe to say that skilful design will reduce or perhaps eliminate accident to the machine and a stoppage of production.

In the second place there is the accident to the worker at the machine supposedly perfect as a machine. Here the quality of the human factor appears, and two lines of research are opened. The first and ideal case of preventability is secured by so interlocking the design of the machine with the operation of tending or feeding it, that the worker cannot have his body, or hands, or clothes, or hair within the danger

zones of its action. For example, one of the most dangerous tools to the operator is the high-speed punching or drawing press, fed by hand. A German design makes it necessary that both the hands of the operator be gripping the actuating levers before the ram acts. The man cannot have his fingers on the clutch levers and under the die at the same time, but the speed of production is sacrificed to the attainment of safety, and piece workers rebel. Here, therefore, the best that can be done is to equip the machine with safety appliances, which shall make it sufficient and unnatural to get fingers within the danger zone, and prevent their getting there by unconscious act or carelessness. The converging pairs of teeth in any train of gears are fatal traps to a man who is thinking of something else, or whose attention is concentrated elsewhere. Danger lurks furthermore for the worker whose vitality has been lowered from any cause, or whose mind is less agile than usual. Poor food, sleepless nights, over-fatigue, dissipation, anxiety at home, a score of circumstances outside the working area may seriously impair the alertness required for self-protection from accident. The engineer, therefore, may properly be expected to safeguard the weaker and less gifted by designing and compelling the use of safety devices which shall minimize the possibility of accidents of this class, even if they may not be prevented entirely.

The economic or productive advantages which follow when preventable accidents are not allowed to occur, will be taken up in a later article.

Jig and Hollow Milling Operation

The jig shown was made for cutting the two tits on the end of the piece marked *A*. The tits are cut with an ordinary hollow mill held in the drill spindle, after as much of the superfluous metal as possible has first been milled away.

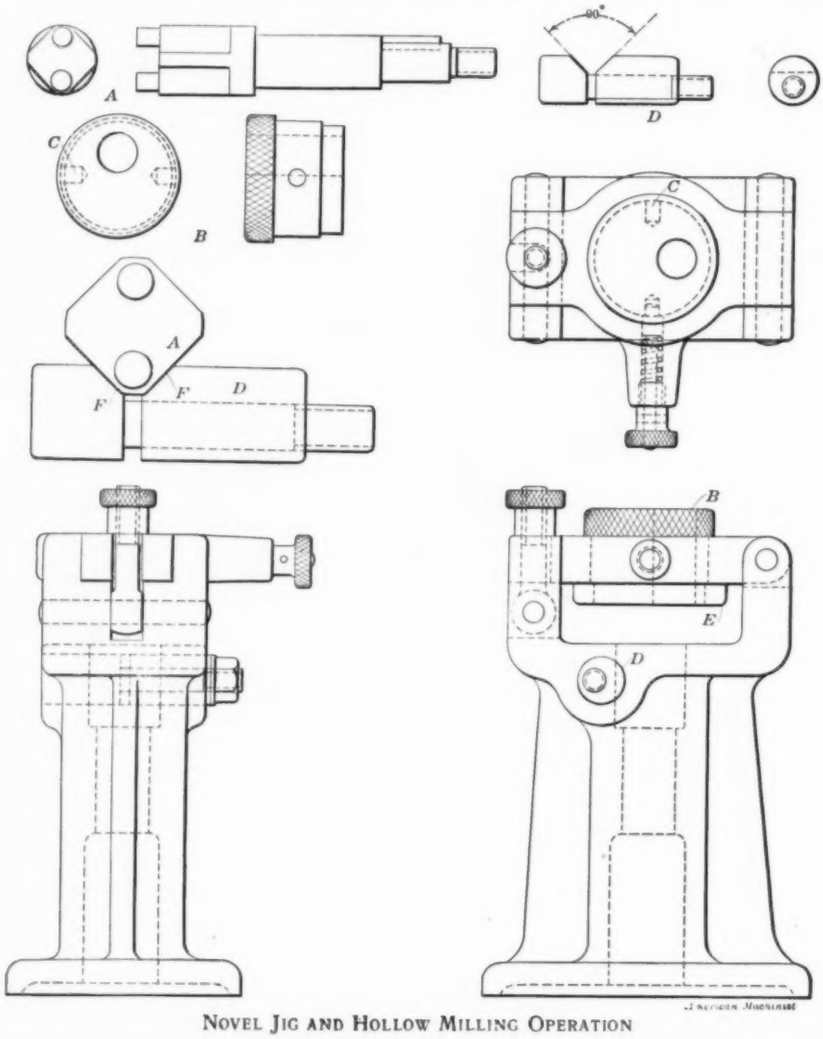
As will be seen, the top of the jig is hinged to allow of the pieces being inserted, and carries a guide bush *B* for the hollow mill. There are two holes *C* in this bush, by which it may be indexed through 180 degrees, and it is located in each position by the spring plunger. The large hole in the bush is eccentric. *E* is a collar fixed on with a couple of screws, for holding bush *B* in place.

In operation, after the piece has been put in the jig, and secured by the clamp bolt *D*, the bush *B* is located in one of its positions by the spring plunger, and the first tit cut. The bush is then revolved through 180 degrees, and the operation repeated.

It will be noticed that the bolt *D* not only holds the piece, but also locates it correctly. For this purpose, instead of the clamping surfaces being milled circular, as is usually the case, they have straight sides forming a 90-degree vee. These grip on the part which has been milled square, as shown at *F*, and at the same time locate it in its correct position.

It has occurred to me that this style of pad bolt might sometimes be of use in connection with small turret tools, where the ordinary type of bolt is not sufficient to prevent the tool from turning. Of course, the usual remedy is to cut a keyway in the turret hole, or to tap in a screw having a plain projecting portion. But there may be cases where it is not desirable to cut the turret, and all that would then be necessary would be to use a bolt of this type, and cut a couple of small flats on the shank of the tool.

Coventry, England. T. BARTON.



NOVEL JIG AND HOLLOW MILLING OPERATION

In a paper presented before the American Society for Testing Materials, dealing with the influence of titanium on bessemer rail steel, a series of tests were described which dealt with ingots of ordinary rail steel and ingots of similar steel to which 0.25 per cent. of titanium had been added during the pouring. There was no trace of the titanium in the steel with which it was used, but there was a marked increase in the soundness of the steel on account of the concentration of the blowholes in the pipe cavity. A great number of drillings were taken from the ingots and analyses of them showed the effect of the titanium was to reduce the segregation of the sulphur, phosphorus and carbon; the results of the silicon and manganese determinations were not given on account of their erratic character, but they did not show segregation. Tests of rails from ordinary and titanium steels were also made and showed the same result.

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American Machinist

Editorial

The Prevention of Industrial Accidents

The attention of most readers of the AMERICAN MACHINIST must have been directed to the forward step which the State of New York has taken in its enacted legislation concerning compensation for accidents in shop and factory. The common law hitherto has given the worker the right to sue his employer for compensation when he was injured while at work. There was no scale set for the amounts to be sought in such compensation suits, and very often the suit in the hands of practitioners of a certain class before the courts became the occasion of a substantial injustice to the employer. To protect himself against this, the employers' liability insurance came into vogue; but neither party to the transaction has been altogether satisfied. The aggrieved victim of the accident did not get for his comfort and use what the employer had to pay as the result of the accident: the employer never knew in any year what expenses he might have to meet in court. There were delays possible, so unfavorable to the injured that a settlement at a low figure was a temptation to him to secure the part of a loaf alleged to be better than no bread. The courts have been congested with inequitable suits; and to protect the employer, the principles of the fellow-servant liability and of contributory negligence have been stretched far beyond the limit of sound application.

Under the new law of New York there is introduced the principle of compulsory compensation by the employer for injuries due to his employment of the man injured; but on a definite scale, and without the introduction of the sympathies of a jury as a factor in the awards. The injury of a worker is a definite charge on the cost of production. The number of accidents in a year is quite a definite figure of experience; and if the cost of each such accident is fixed and the number known, the direct cost of such accidents in any industry becomes known and will be chargeable to the cost of production and payable by the community in the selling prices.

This plan has been working in England since 1897, but is to go on trial in America next year for the first time. Engineers of production may therefore regard the question as one to receive attention in the study of factors in a reduction of costs. This will give special interest and value to an article in this issue on page 179 by one who has given analytical study to some features of the accidents of shop and factory and their possible prevention or reduction in number.

Gages for Sheets and Plates

One of the last bills presented to the House of Representatives before adjournment was one establishing a standard gage for sheets and plates and making it a misdemeanor to sell sheets or plates by any other gage, although allowing a variation of 2½ per cent. in practical use and application.

The gage named for compulsory use is the one adopted by the Government on July 1, 1893, and known as the United States Standard Gage. This varies widely from the wire gages in general use.

There can be no question as to the desirability of a standard gage. As a practical reason for such a standard we have only to quote a notice which the Worcester Pressed Steel Company has found necessary to put on its letters and literature: "Twenty-six numbered gages are used in this country. Please designate thickness of metal in decimals of an inch instead of some numbered gage. This will prevent misinterpretation."

This brings us face to face with the practical side of the question and recalls a suggestion which was made in the columns of this paper twenty-five years ago. This was to make a gage based on a rational instead of an empirical basis.

If every gage number represented a thousandth of an inch, the dullest apprentice would know at once that No. 175 was 0.175 inch in diameter instead of consulting one of the 26 tables and probably getting it wrong. And one-thousandth of an inch is a small enough increment in any case.

In reality this means the abandoment of all gages as we now know them, because their numbers would not be consecutive as few gages have over 45 sizes. But of what use is a gage in such a case any more than to call a half-inch sheet No. 000000? It would be very easy to say that we wanted a 375 sheet, whether we put the No. before it or

not, and there would be little chance of confusion, although it might be easier to call it a number.

There is no question as to the necessity of uniformity and it would seem very much easier to designate thickness by thousandths of an inch than to try to enforce the use of any one of the 26 gages or to attempt to create a new one, unless it was though desirable to add "No." to the thickness in thousandths of an inch. This applies to wire gages with equal force.

Concrete Buildings and Fire Insurance

In considering concrete as a material of construction for factory buildings, its fire-resisting qualities as effecting the fire-insurance rate are worthy of study; especially so as many firms carry no insurance whatever on their concrete buildings.

This subject was treated in a report presented at the recent convention of the National Association of Cement Users. We quote: "Special attention is called to the fact that the information the committee has collated shows that 26.6 per cent. of the buildings covered by replies are not insured by the owners, the type of construction being in each case considered sufficiently fireproof to render insurance unnecessary. Some owners even do not consider it necessary to insure the contents of their buildings, because either the contents are not likely to be destroyed by fire, or the fire could be confined to one room, or in some cases, because the insurance companies specify prohibitive rates, due to the inflammable character of the contents. The committee has been advised by several owners that they have had a fire in one room of their building and that the same was confined to that room."

A few typical replies from concrete-building owners are of interest.

"We think so highly of reinforced concrete construction that we do not carry insurance on our plant nor contents."

"We consider the cement building absolutely fireproof, and therefore carry no insurance."

"We are not afraid of fire either within or without. Rates will have to be low to induce us to carry insurance."

"Our building does not contain a stick of wood, and is so absolutely fireproof that the directors consider it useless to carry insurance, notwithstanding the fact that the———companies give us a rate of 7½ cents."

For the purpose of analysis the answers have been tabulated by districts and classes. District 1 comprises the New England States; district 2, New York, Pennsylvania, West Virginia, Maryland and a portion of Virginia; district 3 Ohio, Indiana, Illinois, Michigan and Wisconsin. Class 2, that we will consider here, comprises heavy manufacturing buildings, devoted to the building of machinery, automobiles, carriages, and the like. In district 1 the average rate, excluding all rates over 0.50, is 0.016; in district 2, 0.12; in district 3, 0.14.

These figures are of interest, but of still greater interest is the factor of 26 per cent. of the owners of concrete buildings reporting "no insurance." A machine shop is better off than many other kinds of manufactories for its contents are non-inflammable, thus both shell and interior are fire resisting.

To the owner contemplating the building of a machine shop we recommend a study of this general advantage of concrete construction as applied to his particular problem—"no fire insurance."

New Publications

We have been favored by the International Acheson Graphite Company with a copy of the volume published by the Press Scrap Book of New York and containing an autobiographical sketch of their president, Edward G. Acheson. This was not originally written for publication but for a family record and tells of his work in railway construction, as a gager with an oil pipe line company; of his work with Thomas Edison and includes his discovery of carborundum, electrically produced graphite and its successful suspension or deflocculation in water and oil as a lubricant. The book contains 143 pages, 6x9 inches and is handsomely bound in limp leather.

Location of Oil Holes

What principle is used in the average drawing room in locating oil holes and providing oiling devices for machinery bearings.

It is probable that no principle in particular is used. The oil hole or cup is usually indicated on top of the bearing, provided that space is not interfered with by some part of the mechanism of the machine, and gravity is relied upon to feed the oil. Surely, the path of least resistance!

Yet the underlying principles are so simple and well known that there seems no excuse for not applying them. Obviously, lubricants should be fed to a bearing at the point of least pressure, provided this feed is from the ordinary cup, siphon, or by rings or a centrifugal method; that is, any method in which the oil is not under pressure. On the other hand, if forced lubrication is used—that is, oil under pressure—it should be fed to the bearing at the point of greatest pressure. In either case the oil will not enter the bearing unless it is under a greater head than the head of the oil film at the point of entrance.

The point of greatest pressure is just before the line of contact between the journal and its bearing, considering the journal as eccentric with the bearing and the point of least pressure is just beyond this line of contact, indicated in both cases in the direction of rotation. This point of contact is readily found if the forces acting on the bearing and its coefficient of friction are known.

Obituary

Edward Blake Dolliver, treasurer of the Standard Screw Company and manager of the Manchester Machine Screw Company, died on July 6, 1910.

Personals*

Joseph H. Jones has been appointed master mechanic of the Maverick Mills, East Boston, Mass.

George Chase recently accepted the position of master mechanic of the Pontiac Mills, Pontiac, R. I.

J. B. Myers, superintendent of the Maxwell-Briscoe Company's shops, at Newcastle, Ind., has resigned in order to establish himself in business in Detroit.

Lieut. Com. Richard M. Watt, U. S. N. has been chosen to succeed Rear-Admiral W. L. Capps as chief constructor and chief of the Bureau of Construction and Repair.

H. Ross Callaway, lately assistant to the mechanical engineer of the New York Edison Company, has joined the staff of Walter B. Snow, publicity engineer, Boston, Mass.

C. M. Ams, of the Max Ams Machine Company, Mount Vernon, N. Y., will leave for Europe in the near future to inspect the company's recently completed factory at Turin, Italy.

David McKinley has been appointed to succeed J. C. Meehan as general foreman of the Wabash shops at Decatur. Ill. Mr. Meehan goes to Toledo to succeed Charles Anderson, resigned.

J. S. Herbert formerly chief engineer of the Atlantic and Gulf Portland Cement Company, has established the Herbert Engineering Company, at Easton, Penn. of which he is president and chief engineer.

L. M. Pomeroy, assistant to the president of the Safety Car Heating and Lighting Company, has become chief engineer of the railway and industrial division of J. G. White & Co., with headquarters in New York City.

*Items for this column are solicited.

New Tools and Shop Appliances

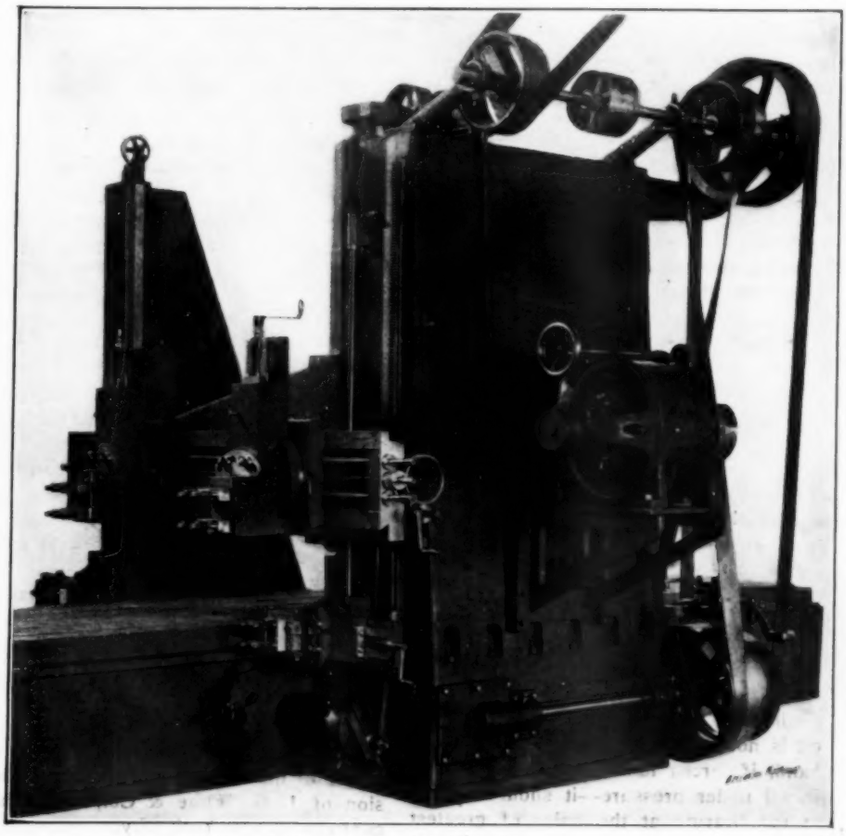
A 60-inch Open Side Cleveland Planer with Removable Outboard Column

The halftone shows a 60-inch by 84-inch by 22-foot open-side planer with removable outboard column built by the Cleveland Planer Works, Cleveland, Ohio. The removable column is not in any way intended for a stiffener for the rail but to allow the use of a fourth head. With the outboard column removed the machine is a true open-side planer.

All gears with the exception of the bull gear and pinion run in oil. All bearings are of phosphor bronze pressed in and easily replaced when worn. Should any of the gearing require repair at any time it can be removed from the sides of the machine without taking the machine apart. The machine is operated entirely above the floor level. The machine is driven by a 25-horsepower variable-speed motor built by the Reliance Electric and Engineering Company. The halftone is reproduced from a photograph of a belt driven planer on which a motor was mounted but not belted up.

ANY and all new or improved machines, tools, or shop appliances of interest to men responsible for results in machinery-making plants will be briefly illustrated and described here—the machine shop news.

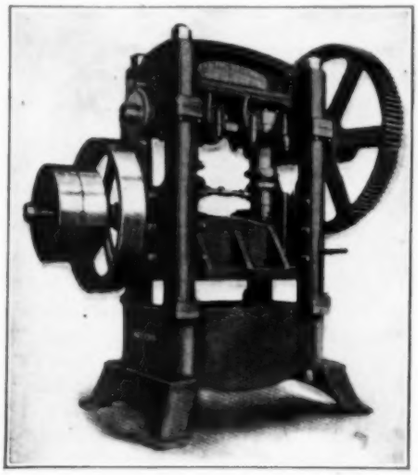
A more full and detailed description will be given—when it is real news—if it can appear here first—before it is sent to other papers. All descriptions appear in ALL four editions of the paper—Weekly, Monthly, Weekly English and Weekly German.



A 60-inch Open-side Planer with Removable Outboard Column

A Large Double Pitman Forming Press

The Max Ams Machine Company, of Mount Vernon, N. Y., has just completed the press, shown in the halftone.



A Large Double-pitman Press

The frame is of the built-up type, the working strain being taken up by four steel rods.

The slide extends through the openings of the uprights at each end, which makes it possible to utilize the entire length of the press bed, and enables it to take sheets 20x48 inches, while the distance between the uprights is 34 inches only. A sheet 25x25 inches can also be worked, fed from front to back.

The eccentrics are solid enlargements of the shaft itself.

The clutch is solid with the shaft and is practically noiseless.

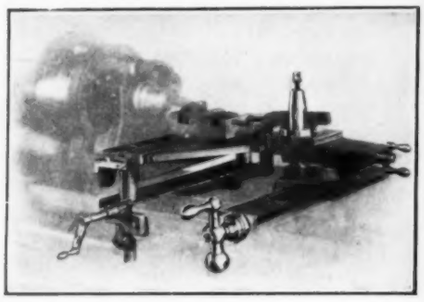
The complete weight of this press is 20,000 pounds. The size of driving pulleys 28x6 inches. Speed 240 revolutions per minute, flywheel 45x6 inches. Weight 1100 pounds, ratio of gearing, 1:8½.

Expansion Boring Tools

The Davis Expansion Boring Tool Company, Inc., 3908-10 North Broadway, St. Louis, Mo., has brought out a line of expansion boring tools. These tools are provided with micrometer adjustment by which the tool is readily set to size. The range of adjustment for each size is considerable, the 1½-inch tool being adjustable up to 2 inches. The larger sizes have, of course, proportionately greater range. These tools are applicable to lathes, boring mills, drill presses and turret lathes.

A Milling Attachment for the Engine Lathe

The illustration shows an extremely handy milling attachment which may be readily fitted to any screw-cutting engine lathe with a width of up to 13½ inches



A Lathe Milling Attachment

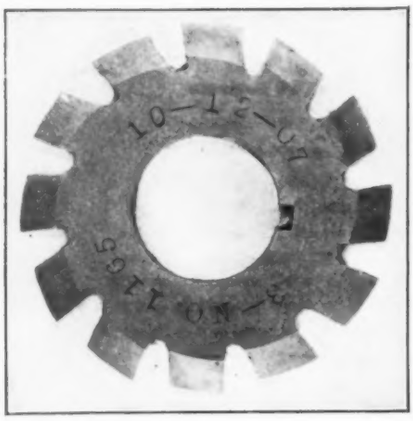
over all. The table is 22¼x4 inches, with one T-slot. It has vertical adjustment of 5 inches, a hand feed of 4 inches and power feed of 8⅞ inches. The power feed used is that of the cross slide of the lathe to which it is attached. The equipment consists of a vise, shown in the halftone, centers and an index head. With these both straight and taper work, such as reamers, may be fluted and spur and bevel gears may be cut.

This attachment is made by the Young Machine and Tool Company, 149-151 Lafayette street, New York.

A Milling Cutter

The halftone shows a new cutter which is being put on the market by Chas. E. Klink, 310 Rutter avenue, Kingston, Penn.

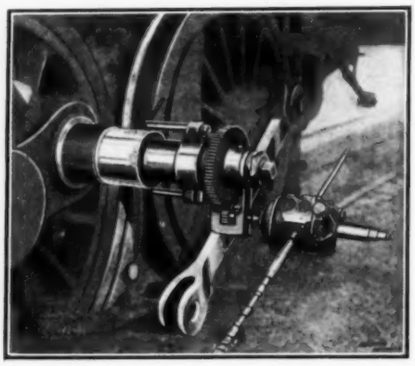
The cutter is made in any shape of high-speed steel and after hardening is ground all over, the teeth being finished with eccentric relief.



A Milling Cutter Finished All Over After Hardening

A Portable Crank Pin Turner

The illustration shows a portable crank-pin turning machine built by the Schwinebraten Portable Crank Pin Turner Company, Birmingham, Ala.



Crank-pin Turner

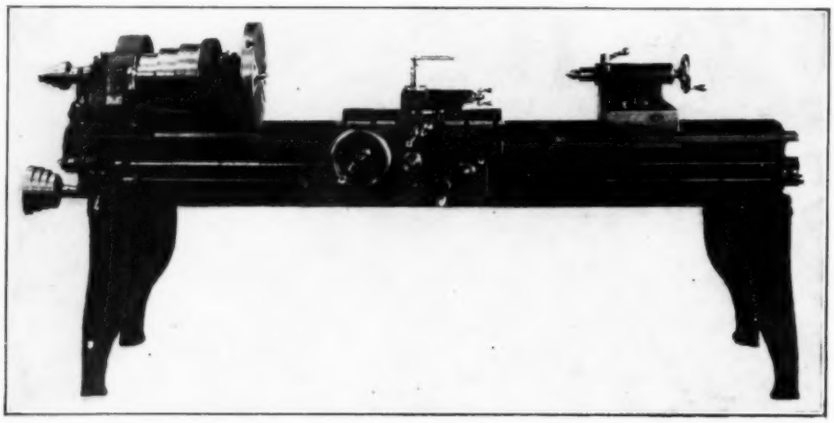
It is fastened as shown by the gudgeon screw tight against the end of the crank pin. As shown in the halftone it is being driven by a pneumatic drill. It will finish a crank pin in an hour and a half. It weighs 80 pounds.

A Double Back Geared Lathe

The halftone shows a 16-inch by 8-foot engine lathe, with double back gear and wide 3-step cone, just put out by the Miami Valley Machine Tool Company, Dayton, Ohio, U. S. A.

The back gears are shifted by the hand lever on headstock, as shown in cut, and have ratios 5.6 and 9.6 to 1. The carriage on this machine has 23½ inches bearing and is gibbed both front and back. The compound rest slide has been lengthened so as to give a 5-inch feed. The tailstock is of offset design, allowing the compound rest to be set parallel with the bed.

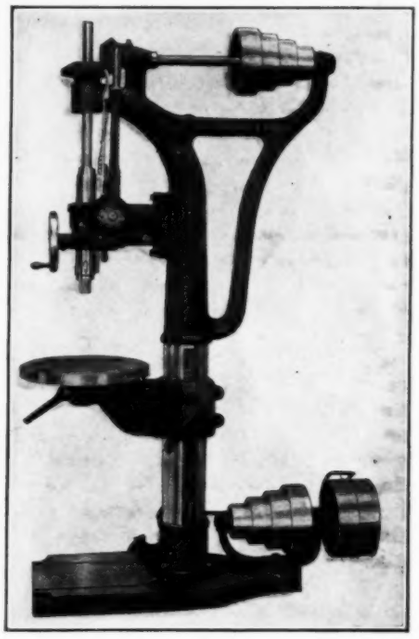
The feed rod can be used either belt or gear driven. Thread-cutting range is 5 to 40 threads, including 11½ threads to the inch.



A 16-inch Double Back-geared Lathe

A Heavy 20-inch Drill Press

The halftone shows a new 20-inch drill press which has just been put on the market by J. E. Snyder & Son, Worcester, Mass. The spindle nose is reamed Morse No. 3 taper. Greatest distance from spindle to base 41 inches, from spindle to table 26 inches. Traverse of table on column 16 inches. Column 6 inches diameter. Weight 785 pounds.



A Heavy Upright Drill

The advantages of all-steel car construction seem to be more apparent with increasing use. The Pennsylvania Railroad has now in service or on order close to 2000 of this type of car, and from present indications future orders for coaches, sleeping and parlor cars will call for all-steel construction.

Various Effects of Titanium on Steel

By E. F. Lake

A new alloying material that acts as a purifier of steel by removing the oxygen and nitrogen. It increases the static and dynamic strengths and wearing qualities of the metal. It also increases the density, hardness and elasticity of steel and prevents the formation of blow-holes.

Titanium belongs to the same chemical group as silicon and three other quite rare elements, and in some respects resembles carbon. It forms one compound with oxygen, namely, TiO_2 and this titanium dioxide occurs in nature in three distinct forms. The principal one of these is the titaniferous ore that contains ferrous titanate, $FeTiO_3$.

In its natural combination with iron it is almost impossible to make it beneficial to the steel products. When separated in the electric furnace, however, and made into a ferro-titanium that contains from 12 to 15 per cent. titanic acid, about 6 per cent. of carbon, and 5 per cent. of all other impurities, with the balance iron, it greatly improves steel and iron, if added in the proper proportions.

Titanium burns more energetically in oxygen than any other known substance. When heated in oxygen it creates an instantaneous dazzing flame like lightning. Its combination with nitrogen gas is attended with the evolution of heat, it being the only undisputed example of the combustion of an element in nitrogen. While nickel, chromium, molybdenum and tungsten add certain good qualities to steel, none of these combines with nitrogen and thus removes it from the metal as titanium does.

Affinity for Nitrogen

Titanium has a great affinity for nitrogen and carries this off into the slag, and nitrogen is, at least, as detrimental to the physical properties of steel as phosphorus and it is present in larger percentages than has hitherto been supposed. It affinitizes to a slightly lesser degree with oxygen and removes this also. While sulphur and phosphorus are not removed to any great extent by titanium, by removing the oxygen and nitrogen it prevents these from forming oxides and nitrides and these are the real injurious substances. Titanium, by combining with the gaseous nitrogen, forms a stable nitride that shows as tiny red crystals under the microscope. This it carries off into the slag and greatly increases the quantity that is removed or lifted from the molten metal. Unless an unnecessary quantity of the alloy is used, the titanium itself passes off with the slag, and will not show on the analysis of the metal. The titanium itself is of no special benefit as a component of the finished steel and only enough should be used to remove the impurities. Any excess above this will remain in the steel, and if proof is wanted that one is buying a titanium-treated metal, enough of the alloy could be used to show by an analysis, as a small percentage left in the steel is not harmful.

One instance of the removal of nitrogen was shown in some ordinary bessemer-steel rails that were found to contain from 0.013 to 0.015 per cent. of nitrogen. When 0.50 per cent. of ferro-titanium, containing 15 per cent. of titanic acid, was added the nitrogen was reduced from 0.004 to 0.005 per cent. As it also has a strong affinity for oxygen it provides a simple means of thoroughly deoxidizing steel.

Titanium, by removing the oxygen and nitrogen, prevents the formation of blow-holes in steel. It also reduces the size of the pipe, as it makes the bath more liquid by freeing it from the free oxide and slag. This makes the metal subside in the mold while cooling, and the pipe will be smaller and flatter. It also makes it roll well. In this connection the record of a day's work in rolling, as taken from a pyrometer, showed an increase of not less than 30 degrees Fahrenheit in the heat of the metal at a given point. That is 30 degrees above that of untreated metal at the same point, while passing through the roll. The metal, almost invariably, does not boil, but lies dead in the ingot molds.

Physical Properties

Due to the removal of nitrogen and oxygen from the steel, the physical properties are improved and its density increased. The tensile strength, elastic limit, reduction of area, transverse strength, hardness, elasticity, wearing qualities, resistance to shocks, and torsion are greatly improved. Thus titanium gives practically the same results as vanadium. One example of its ability to withstand torsional strains was shown with a bar 4 feet long and 1⅛ inches square. This was twisted through seven complete revolutions without the sign of a fracture. The Brinell hardness test shows titanium steel to be softer than ordinary steel rails of the same analysis and section and this is probably due to the finely divided ferrite network.

Segregation

A ferrotitanium alloy that contains from 10 to 15 per cent. of titanic acid gives the best results, as this goes into almost instant solution. When a higher percentage is used, the titanium is always liable to segregate, as it has a much higher melting point than that of steel. Thus, when a 25 per cent. alloy was tried, nothing was gained by its use. When, however, an alloy is used that will allow the titanium to enter into solution in the molten metal, it retards the segregation of the other ingredients and produces a very homogeneous steel.

Percentage to Add

One per cent. of the 10 to 15 per cent. ferrotitanium alloy is all that is necessary to add to the steel, as this amount will seize all of the nitrogen and probably all of the oxygen that has been left in the bath. In many cases this can be reduced to one-half of 1 per cent., and after some experience in its use the one-half of 1 per cent. might be sufficient for all steels. This small amount removes the bulk of the blow holes and segregation found in bessemer steel, and in the case of steel rails it only increases their cost about $2 per ton. With the titanium-steel rails, numerous service tests have been made and all of these prove that they wear about three times as long as the ordinary steel rails, while in some cases they have outworn six of the bessemer rails.

Method of Adding Alloy

In the bessemer and open-hearth processes of steel making it is always best to add the ferrotitanium in the ladle. It should be shoveled in loosely and never preheated but used cold. The first shovelful should be put in after the bottom of the ladle is well covered with molten metal and after the ferromanganese has been added, when this is put in the ladle. One shovel at a time should then be put in while the ladle is filling, so as to give it the benefit of the swirling and churning in the molten mass. The last shovelful should be added before the ladle is three-quarters full. One reason for this is that the alloy is lighter than iron and would not sink and disseminate through the bath if it were added near the top. Another reason is that if it were near the slag it would unite with the nitrogen in the slag and consequently would not benefit the metal.

The alloy should never be used in connection with aluminum, as aluminum adds brittleness, and titanium removes brittleness, hence the two alloys are antagonistic and the titanium will do its work much better alone.

In crucible-steel making it is sometimes preferable to add the titanium alloy with the charge of metal that is to be melted down, and in this case it should be added well down toward the bottom

of the crucible. It has, however, been successfully added after the metal is boiling and when the manganese is added. At this time the titanium alloy should be added after the manganese. In fact, at all times it should be the last material added to the bath.

Increase in Temperature

After adding the alloy, the ladle of metal should be held for from 5 to 15 minutes before pouring in order to allow the titanium to do its work and scavenges out the oxygen and nitrogen. There is no danger of the metal in the ladle becoming chilled by holding it, as the reaction caused by titanium causes its temperature to rise rather than lower, and the metal is in better condition for pouring after standing than before. In one case a ladle of steel was held for 20 minutes after tapping and adding the titanium, and it was then in better condition for pouring into ingots than is steel without titanium soon after it is tapped. The increased heat of the molten metal, due to the reaction of titanium, ranges from 50 to 90 degrees Fahrenheit above that of ordinary steel held in the ladle for the same length of time.

Titanium also prevents steel from heating up as quickly as the steels in which it is not used. An instance of this was some titanium-treated ingot molds that did not show red in the dark when filled with molten steel, whereas the ordinary ingot molds standing beside them were distinctly red hot. The metal is also comparatively slow in heating from friction, and this is one of the causes why metals treated with it are much more durable than others. Steels treated with titanium heat up more slowly than others when machining them. The cutting speed can therefore be increased and the machine work done more quickly. This also makes it very advantageous to use in tool steels; whether of the carbon or high-speed kind.

Lower Heat Increase from Friction

Owing to the fact that titanium increases the heat of the molten metal to a very marked degree it is seldom necessary to use much ferrosilicon, as silicon is largely used for this purpose. Silicon, however, is not so efficacious and is known to, at times, precipitate phosphorus, with disastrous results. Thus, when titanium is used the amount of ferrosilicon should be decreased and if possible eliminated entirely. If not eliminated entirely it could be reduced from time to time until no further improvement is noticed. If defects are found in the surface of the finished steel a slight increase in the ferromanganese and a decided decrease in the ferrosilicon used will overcome that.

Steel castings that have been treated with titanium are more blue in color, free from blow holes and brittleness, and heat less under cutting tools than ordinary steel castings; thus they can be machined more easily and rapidly. The transverse strength has been increased from 17 to 23 per cent. by its use.

Titanium increases the breaking strains, wearing qualities and hardness in the chill of cast iron, and hence is very beneficial for such castings as car wheels, but it decreases the chilling effect.

Titanium also promises some good results when used in copper, brass or bronze, in which case a cuprotitanium instead of a ferrotitanium is used. This has been used in about the same proportion as the ferro, but the best results have been obtained in copper with from 1½ to 2 per cent. of the cuprotitanium.

Setting Eccentrics in the Floor

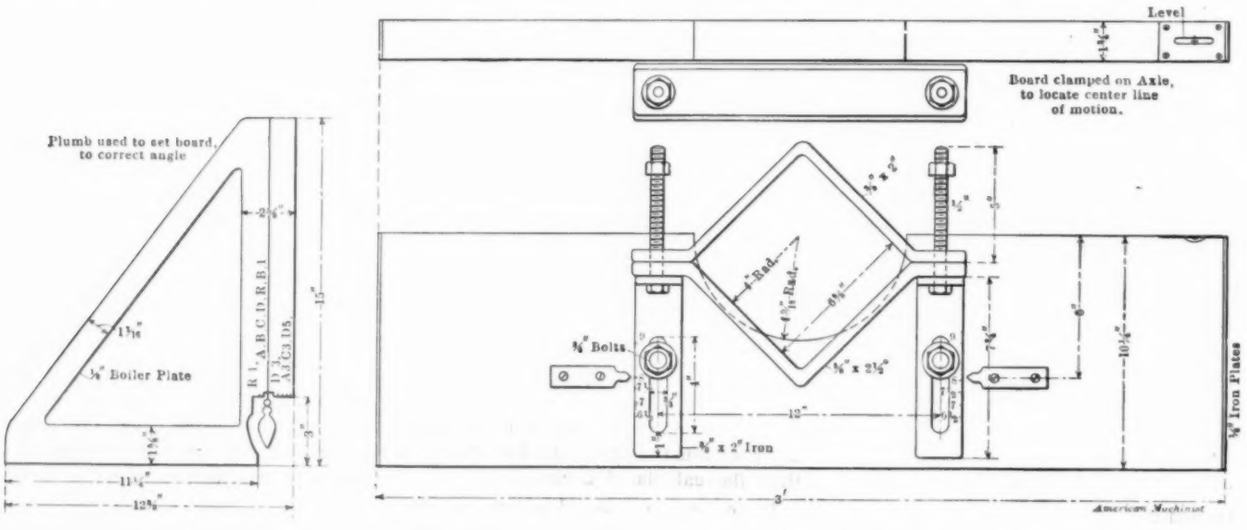
By Chas. Markel

In setting eccentrics on locomotive axles, we have found it very inconvenient to key on eccentrics and properly fasten them under an engine, especially on the large engines where things are so compact underneath as to give very little room to work.

It is much more convenient and satisfactory to set the eccentrics, cut the keyways if it is a new axle, key them on and finish them on the floor while the wheels are out. It is very important that the eccentrics be keyed securely as they frequently work loose on the keys, which cripples an engine's valve motion. This is a trouble that is not easily located by the engineer, nor the inspector, as they appear all right until the engine is working. Many engines are condemned and sent to the shop when the main trouble is one or more loose eccentrics.

We have set all eccentrics in our shops on the floor for the last fifteen years, and we seldom have one to alter when we set the valves. If, as sometimes happens, they do not appear right at first we usually find the trouble somewhere else, such as reach rod not being the right length or the quadrant, reverse shaft or link lifters not being correct.

The setting of valves is a small task when the eccentrics are placed correctly. It is simply necessary to adjust the blades, see that the engine is square when hooked up, and fill out the valve report.



Device for Setting Eccentrics Before They Go Under the Engine

Our method of setting eccentrics is simple. We have a board 1½ inches by 10 inches by 3 feet, a half circle the size of the largest shaft about 9 inches cut out in the center, a V-clamp on the side of the board to fasten it on the axle as shown in the illustration. This clamp can be raised or lowered so as to bring the top of the board to the center of any size axle. A small level is inserted at one end so that if the line from the center of the drivers to the center of the link block is level we level the board.

If the center line is not level with the engine on the wheels, then we use a plumb-bob and set the board to the right incline. The plumb-bob frame can be marked for the proper incline for different classes of engines. We clamp the board on the axle up against the eccentrics, put the crank pin on the dead center forward or back by plumbing the pin on the opposite side, put the eccentric plumb on the shaft, top or bottom as the case may be. This brings the valve on the middle of the seat, then we give it the proper angular advance toward the crank, measuring on top of the board, and mark the keyway.

The proper amount of advance depends, of course, on the outside lap of the valve and the lead we wish to give it. If the lap is 1 inch and we wish to set it ⅛ inch negative lead, we advance it ⅞ inch provided both inside and outside rocker arms are the same length. If the outside arm is 1/12 longer than the inside one, we deduct 1/12 on the advance of the eccentric.

This plan was worked out by Harry Edwards, one of our machinists.

Shifting Center for Taper Turning

By Yarkichi Lekiguchi

It is general practice in machine shops to shift the dead center for taper turning. But the question often arises; how much shall we shift the center in order to get required taper?

Some machinists space the two centers equal to the length of work and then shift the dead center just equal to one-half of difference of diameters at the two ends.

Several text books of machine tools give the same process as described above, but this is not correct. Fig. 1 shows the work which is already turned to required taper. Referring to the figure $b\,m$ shows the distance from the center line of lathe,

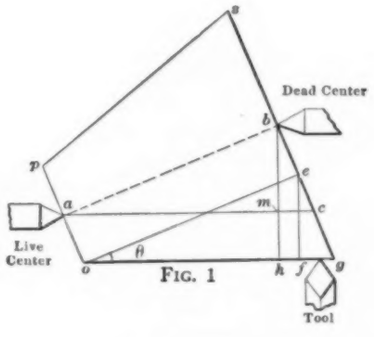


FIG. 1

SHIFTING DEAD CENTER THEORETICALLY

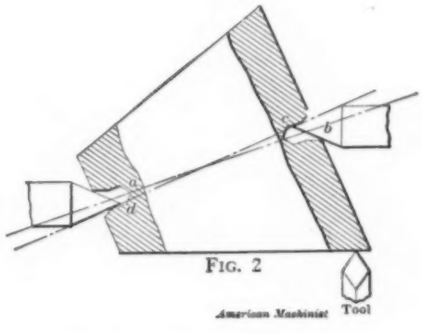


FIG. 2

SHIFTING DEAD CENTER IN PRACTICE

through which dead center is shifted. Draw $o\,e$ perpendicular to the bases and also draw two lines $b\,h$ and $e\,f$ perpendicular to $o\,g$.

Let

$d = o\,p$ = Small diameter;
$D = s\,q$ = Large diameter;
$l = a\,b$ = Length,

and

t = Required taper (inches per foot).

Then

$$t = \frac{D-d}{l}.$$

In figure

$a\,o = b\,e$ and $a\,o = c\,g \therefore b\,e = c\,g$
$b\,e + e\,c = c\,g + e\,c$ so $b\,c = e\,g$

and therefore triangle $b\,m\,c$ = triangle $e\,f\,g$, so $b\,m = e\,f$

$$e\,f = e\,g \cos.\,\theta$$

but

$$e\,g = \frac{D-d}{2} \text{ so } e\,f \text{ or } b\,m = \frac{D-d}{2} \cos.\,\theta. \quad (1)$$

So we must shift the center a distance equal to $\left(\frac{D-d}{2}\right)\cos.\,\theta$.

The above, moreover, is only true on paper and is not right in practice. For in Fig. 1 the work is assumed to be supported on points, which cannot be performed in practice.

Fig. 2 shows the true condition of work in lathe. In this case the center line $c\,d$, through the lathe centers does not coincide with the center line of work $a\,b$. Thus if we shift the dead center just equal to $\left(\frac{D-d}{2}\right)\cos.\,\theta$ we get less taper than required. So in order to get exact taper we must shift the dead center more than the calculated distance.

In conclusion I would say that in this process of taper turning the degree of accuracy depends entirely upon the skill of the machinist, so before we set the work in proper position we must change the center several times.

Invention and Simplification

The problem of designing and inventing a method, machine or process for obtaining certain results is frequently a brain-racking problem, but usually it does not begin to compare with the subsequent problems of reducing results to a commercial basis and selecting such parts of the inventions or designs as will enable the results to be placed upon the market at the lowest possible cost (to the manufacturer) and at the same time, the result must possess the qualities of being foolproof and office-proof.

In fact, the specifications embodying the three above-mentioned requisites would resemble very much the specifications given to the contractor whenever a deal is made to erect a section of fence in Florida and some of the other Southern States. The fence qualifications read that the fence shall be: "Horse high, hog tight and bull strong" and these qualifications should fit the requirements for each and every invention or design.

In a recent bit of practice, the problem arose to hold in a rigid, easily adjusted position, a steel blade 3x18 inches, pivoted at one end to swing horizontally and to permit any adjustment within 30 degrees without the use of set screws, latches, wedges or levers. The device must be so simple that a fool could put it together and work it, yet strongly made and accurate.

The accepted design was the eighth, seven schemes having been developed and rejected as unsatisfactory. In this instance, the invention upon being reduced to its best form, simplified itself, the whole device, aside from the lever-arm to be held and the rod to which the device was attached, consisted of only two pieces, a horseshoe-shaped spring made from No. 26 gage steel, and a single ¼-inch rivet.

Increasing Shop Capacities

METAL WORKING

Fire in the Pullman car shops at Chicago did $100,000 damage.

The Moline (Ill.) Pole and Shaft Company is building an addition.

The Otis Elevator Company, Quincy, Ill., is extending its plant.

Frank M. Rausbottom will build a modern garage at Roseville, Ohio.

C. J. Moberg is building a die-casting foundry at Mt. Vernon, N. Y.

E. M. Benford, Mt. Vernon, N. Y., will enlarge his spark-plug factory.

C. T. Shaw, Natchez, Miss., will enlarge and improve his iron foundry.

Fire destroyed the plant of the Sandbloom Iron Works, Greenpoint, N. Y.

The Temple (Tex.) Iron Works will establish a foundry at San Angelo.

Avery Plow Company, Peoria, Ill., is building a large addition to its plant.

The Canadian Northern Railway will build large car shops at Kamloops, B. C.

E. B. Collier, Wahoo, Neb., is putting up a building to be used as a garage.

The Matt De Freest Garage, Albany, N. Y., was destroyed by fire. Loss, $25,000.

The Dickson Malleable Iron Company will erect a new plant at Milwaukee, Wis.

The Woburn (Mass.) Machine Company will make large additions to its plant.

The Pennsylvania Railroad will erect a large new roundhouse at Altoona, Penn.

The Taylor Motor Company, Hutchinson, Kas., is erecting an addition to its plant.

Messrs. Wray and Nicholls are building a large automobile factory in Toronto, Ont.

The Quanah, Acme & Pacific Railway Company will erect a roundhouse at Quanah, Tex.

The Ohio Pattern Works, Cincinnati, Ohio, is planning an addition to its brass foundry.

The Angidile Computing Scale Company, Elkhart, Ind., will erect a new $75,000 plant.

Fire destroyed the plant of the Globe Foundry and Machine Company, Sheboygan, Wis.

It is stated the Vulcan Gear Works, of Detroit, Mich., will build a plant at Pontiac, Mich.

The Angola (Ind.) Engine and Foundry Company is to make extensive repairs at its plant.

The S. W. Card Company, Mansfield, Mass., manufacturing taps, etc., is building an addition.

Shipbuilding plant of Henry B. Nevins & Co., on City Island, N. Y., was burned. Loss, $25,000.

The Pratt-Messler Manufacturing Company, St. Louis, Mo., will build additions to its foundry.

The J. W. Lathrop Company, Mystic, Conn., building gas engines, will erect an addition to its plant.

It is reported the Mason-Maytag Auto Company will enlarge its plant at Waterloo, Iowa.

The Grand Trunk Pacific Railway will locate a roundhouse and shops at Fort William, Ont.

The Auto Car Company, Ardmore, Penn., is seeking suitable location around New York for a plant.

News items for the sales department—where more equipment will be needed. Authentic news is solicited for this department, not rumors or gossip—facts.

J. S. Bloom, Independence, Iowa, is erecting a new factory for the manufacture of feed grinders.

John Z. Evans, Albia, Ia., is interested in a new machine shop and factory to cost about $20,000.

The Chicago, Ottawa & Peoria Railway will commence work on its machine and forge shop at Ottawa, Ill.

The Erner & Hopkins Company, Columbus, Ohio, will engage in the manufacture of engines and generators.

The Deemer Steel Casting Company, New Castle, Del., will erect an addition to be used for chipping department.

The Taylor Steel Company, Canton, Ohio, will erect a new plant for the manufacture of crucible-steel forgings.

The Emerson Engine Company, Washington, D. C., is looking for suitable site on which to erect its plant.

The Globe Seamless Steel Tube Company, Milwaukee, Wis., has purchased site on which a new plant will be built.

The Smalley Manufacturing Company, Manitowoc, Wis., will build a machine shop, foundry and planing mill.

The Holbrook-Armstrong Iron Company, Racine, Wis., is enlarging its plant and will manufacture motor car parts.

The Ansted Spring and Axle Works, Connersville, Ind., has awarded contract for the construction of a new plant.

The General Motors Company will erect an addition to its plant at Clyde, Ohio, to be used as a machinery building.

The Nickerson-McFarlen Machinery Company, Tacoma, Wash., will build a large machine shop near its present plant.

Tennison Bros., Laurel and Third streets, Texarkana, Ark., will install machinery for making metal pails, oil cans, etc.

The Sunlight Manufacturing Company, Tampa, Fla., is preparing plans for the establishment of an automobile plant.

Contract has been awarded for three one-story additions to the plant of the Nelson Valve Company, at Wyndmoor, Penn.

The Sharples Separator Company, of West Chester, Penn., has purchased site in Chicago and will erect a $100,000 building.

The Bower Roller Bearing Company, of Dayton, Ohio, has purchased site at Detroit, Mich., where a new plant will be erected.

A. Wendland, Lutzower Strasse 6, Berlin, Germany, would like catalogs of machines for sheet-metal and wire-working factories.

The Fort Dodge (Ia.) Iron and Metal Company will erect a foundry for the smelting of junk and the molding of rough castings.

Permit for the erection of an addition to the plant of the Overland Automobile Company, Indianapolis, Ind., has been taken out.

J. H. Davis, Salt Lake City, Utah, is interested in the organization of a new company for the manufacture of steam plows.

The Des Moines (Iowa) City Railway Company will soon commence work on a new car barn to replace the one recently destroyed by fire.

The Cleveland (Ohio) Hardware Company will install new equipment, including shapers, lathe, planer, radial drill, boring mill, steam hammer.

R. K. Luhar, Gheekanta, Limda Pole, Baroda, India, watchmaker, is inquiring for clockmakers' and watchmakers' machinery and tools.

The Western Pacific Pipe and Steel Company, San Francisco, Cal., has secured site at Richmond, on which a $100,000 plant will be erected.

The Case Cutlery Company, Smethport, Penn., whose plant was burned a short time ago, is making investigation toward securing another location.

The United States Hoffman Company, Syracuse, N. Y., will erect an addition to its plant. The company manufactures clothes-pressing machines.

The Dominion Stamping Company, Ltd., Walkerville, Mich., has plans completed for a new factory for the manufacture of hoods, tanks, fenders, etc.

Plans for the new shops of the Chesapeake & Ohio Railroad to be erected near Richmond, Va., are now completed and construction will probably begin shortly.

The list of tools required for the locomotive shops for the Wheeling & Lake Erie Railroad Company, Brewster, Ohio, will be sent out in the near future.

A factory for the manufacture of motor parts and tools is being constructed at Dunnville, Ont., by Messrs. Fowler & Sampson, of Detroit and Toronto.

The Chesapeake & Ohio Railroad is building a roundhouse and blacksmith shop at Silver Grove, Ky., and also intends erecting a roundhouse at Russell, Ky.

Fire destroyed the foundry, machine shop, bolt, rivet and forge departments, of the Pittsburg (Penn.) Manufacturing Company, causing a loss of about $75,000.

C. A. McKiernan, Carthage, Mo., has invented and patented a new automobile, and is said to be organizing a company for the purpose of manufacturing same.

It is stated that about $200,000 will be expended in new equipment for the addition now being erected by the N. Y. C. & H. R. R. R. at the Albany, N. Y., shops.

It is reported the Union Pacific Railway has made an appropriation of $25,000 for the construction of roundhouse and freight-car repair shops in Council Bluffs, Iowa.

The Nisqually Iron Works, Tacoma, Wash., which recently incorporated, will establish a plant in the old Bismarck car-shop buildings of the Tacoma Eastern Railroad.

Charles J. Anderson, proprietor of the Menominee (Wis.) Iron Works, which recently burned, is considering the rebuilding of its plant, or will move to another location.

Robert Morris, president of the Central Concrete Construction Company, Louisville, Ky., is promoting a company for the purpose of establishing an automobile factory.

The Thomas A. Edison Company is said to be contemplating the establishment of a plant, probably in Cincinnati, for the manufacture of the Edison-Beach storage-battery cars.

The Tabor Manufacturing Company, Philadelphia, Penn., manufacturing molding machines, cold saws, etc., has purchased site for a new plant, which, it is said, will cost about $200,000.

The Metals Welding Company has purchased land at Perkins avenue and East Fortieth street, Cleveland, Ohio, and will proceed at once with the erection of a $15,000 factory building.

John D. Owens and A. E. Cheney, of Marion, Ohio, are forming a company to establish a plant for the manufacture of steam shovels, dredges, etc. Site for the plant has been secured.

The Autocar Company, which is building a large garage at Twenty-third and Market streets, Philadelphia, Penn., is in the market for a 300-light plant. Will also need machine-tool equipment, etc.

Bids will soon be called for the construction of shipbuilding and dry docks for the Great Lakes Engineering Works, at Ashtabula, Ohio. There will be two machine shops, blacksmith shop, costing $500,000.

Fire at the plant of the McFarland Foundry and Machine Company, Trenton, N. J., did $15,000 damage. The boiler house, chipping room and building where castings are cleaned were destroyed.

The Brightwood Manufacturing Company, now located in the building occupied by the Consolidated Wrapping Machine Company, at Springfield, Mass., is planning the erection of a plant on site still to be decided on.

The General Electric Company is inquiring for machine tools for the plant at Erie, Penn., including power hack saw, 60-inch boring mill, wet tool grinder, bolt cutter, engine lathe, etc., for installation in a gray-iron foundry.

The Casimir Von Philip Company, Bethlehem, Penn., has plans under way for the erection of a plant for the manufacture of the Casimir printing press. Casimir Von Philip is manager of the machinery department of the Bethlehem Steel Company.

General Manufacturing

W. H. Elton will erect a large tile plant at Richland, Iowa.

The town of Raymond, Alberta, will build a new waterworks plant.

The Rhinelander (Wis.) Refrigerator Company is building an addition.

The Consumers Gas Company, Reading, Penn., will enlarge its plant.

The Wallaceburg (Ont.) Oil Company is making extensive improvements.

The city of Foss, Okla., contemplates installing an electric-light system.

The Fulton Market Company, Atlanta, Ga., will install a cold-storage plant.

The Texarkana (Tex.) Water Company will build a new pumping plant.

The Standard Oil grease plant at Whiting, Ind., was burned. Loss, $200,000.

The Shaver Carriage Company, Des Moines, Iowa, will erect a $20,000 addition.

Extensive improvements will be made in the waterworks system at Temple, Tex.

The sawmill of Brooks-Ross Company, Schofield, Wis., was burned. Loss, $50,000.

The American Shipbuilding Company, Lorain, Ohio, is building a new forge shop.

The Smith Cotton Gin, at Paris, Tex., recently destroyed by fire, will be rebuilt.

The M. A. Gedney Pickle Company will build a new factory at Cumberland, Wis.

The Riegel Sack Company, Jersey City, N. J., will erect a new $75,000 factory.

The city of Meigs, Ga., will vote on issuance of $20,000 bonds for waterworks.

The Lehigh Portland Cement Company, Mason City, Iowa, will erect a new plant.

The Hartford Stone Company, Youngstown, Ohio, will increase the capacity of its plant.

The T. A. Gillespie Company is enlarging the municipal power house at Massena, N. Y.

The Dominion Sugar Company, Wallaceburg, Ont., is making additions to its plant.

The plant of the Dayton (Ohio) Reduction Company was burned. Loss, about $40,000.

The plant of the Chippewa Falls (Wis.) Chair Company was burned. Loss, $25,000.

Main Bros. Box and Lumber Company, Karnak, Ill., is seeking site for a branch plant.

The flour mill and grain elevator of Woods & Dunlap, O'Fallen, Ill., was burned. Loss, $50,000.

Fire destroyed the plant of the Consolidated Ice Company, Clinton, Mass. Loss, $10,000.

Fire destroyed the plant of the Seeds Grain and Hay Company, Columbus, Ohio. Loss, $25,000.

The plant of the Pioneer Broom Company, Amsterdam, N. Y., was burned. Loss, $90,000.

The United Zinc and Chemical Company, Springfield, Ill., will erect two additional buildings.

City of White Springs, Fla., will vote on $45,000 bond issue for lighting plant, waterworks, etc.

The Laconia (N. H.) Electric Lighting Company is building a new power house at East Tilton.

The Houk Falls Power Company is increasing the capacity of its power plant at High Falls, N. Y.

The McGraw Tire and Rubber Company, East Palestine, Ohio, is erecting an addition to its plant.

The Argillo Works, Carbon Cliff, Ill., manufacturing tile and paving brick, is erecting new building.

Sioux City, Iowa, will probably purchase a new turbine pump of about 1,500,000 gallons daily capacity.

The city of Rockmart, Ga., will vote on $25,000 bond issue for waterworks. I. F. Mundy, mayor.

The plant of the Amarillo (Tex.) Ice and Cold Storage Company was destroyed by fire. Loss, $100,000.

F. S. Hinds, 19 Milk street, Boston, Mass., is taking estimates for power equipment for the Meritas Mills.

Herbeck & Demer, Honesdale, Penn., cut-glass manufacturers, are looking for a site for a new plant.

The mule room at No. 1 mill of the Hargraves Mills, Fall River, Mass., was badly damaged by fire.

The plant of the American Cement Plaster Company, Quanah, Tex., burned some time ago, is to be rebuilt.

The lumber plant of the A. G. Breitweiser Company, Pittsburg, Penn., was destroyed by fire. Loss, $50,000.

The Goshen (Ind.) Furniture Company is seeking a location in the southwest for establishing a factory.

The Kane (Penn.) Blind and Screen Company, whose plant recently burned, is planning to rebuild same.

The Schwarzschild & Sulzberger Company will build a $1,000,000 packing plant at Oklahoma City, Okla.

The Chicago (Ill.) Thread Company will erect a factory at Monticello, Ind. Will have a small power plant.

The Kenosha (Wis.) Electric Railway Company is considering plans for a new steam-turbine power station.

Fire at the plant of the Southern Pipe and Foundry Company, North Birmingham, Ala., caused $8000 damage.

The planing mill and drying sheds of the Park Rapids (Minn.) Lumber Company were burned. Loss, $50,000.

The cold-storage warehouse of F. C. Linde & Co., 48-52 Jay street, New York, was burned. Loss, $200,000.

The Atlantic City Water Works, Absecon, N. J., will rebuild its pumping station. Two new boilers will be installed.

The city of London, Ont., will buy two 3,000,000-gallon turbine pumps and two 250-horsepower synchronous motors.

The plant of Ehret Magnesia Manufacturing Company, Port Kennedy, Penn., was destroyed by fire. Loss, $250,000.

The American Ice Company, Calvert building, Baltimore, Md., will erect an ice plant on Franklin street, near Payson.

The Chickering Piano Company, Chicago, Ill., has purchased site on which a new seven-story building will be erected.

The Burlington (Vt.) Light and Power Company is erecting a new building to be used as a dynamo and boiler room.

A new armory to be equipped with latest appliances, costing $50,000, will be erected for the M. N. G. Co. 5, Hudson, Mass.

The Holman Manufacturing Company, Sheboygan, Wis., overall manufacturers, will probably build a new plant in the fall.

The city of Springfield, Ill., will receive bids for pumping engine of 12,000,000 gallon daily capacity for waterworks system.

The Eller Wagon and Carriage Company, Houston, Tex., has awarded contract for the erection of a new three-story factory.

The Heaton Wagon Company, Neosho, Mo., is said to be trying to secure site for the establishment of a new wagon factory.

H. P. Gifford, president, Salem (Mass.), water board, requires bids on two 78-inch boilers for the Salem pumping station.

The plant of the American Reduction and Fertilizer Company, Kansas City, Mo., was damaged by fire to the extent of $10,000.

Charles Hale & Bro., Philadelphia, Penn., will erect a new four-story factory for the manufacture of leather and shoe findings.

The Franklin (N. H.) Needle Company will erect a new power plant. Two turbine wheels of 60 and 30 horsepower will be installed.

The Brooklyn Cooperage Company, St. Regis Falls, N. Y., has purchased property at Reynoldston, N. Y., and plans to build.

The S. W. Card Manufacturing Company, Mansfield, Mass., is making an addition and will require electric motors for shaft drive.

The Tennessee Mantel Manufacturing Company, Knoxville, Tenn., will move to Oakwood, where a new plant will be erected.

The Chicago-South Bend Electric Company will install $140,000 worth of additional equipment in its plant at Michigan City, Ind.

The Kimberly-Wing Company, Cedars, Miss., is looking for a suitable location for a plant for the manufacture of interior furnishings.

The Magnesia Asbestos Company, 122 East Twenty-fifth street, New York, is looking for a suitable location on which to establish a plant.

The city of Boulder, Colo., is planning to extend and improve the water system, on which, it is said, about $500,000 will be spent.

The Pioneer Pearl Button Company, of Muscatown, Iowa, has decided to locate in Poughkeepsie, N. Y., and will erect a plant there.

The board of supervisors, of Erie county, Buffalo, N. Y., is securing bids for power and lighting plant at the Erie county penitentiary.

The Falconer Company, Baltimore, Md., will build a new five-story plant at Gay and Water streets for the manufacture of stationery.

The water commissioners, Newburyport, Mass., are in the market for a 700-gallon per minute triplex pump and a 40-horsepower oil engine.

The Sanitary Pottery Company, Evansville, Ind., is planning the erection of a $200,000 addition for the manufacture of bath-room equipments.

The Van Camp Packing Company, Indianapolis, Ind., is trying to secure suitable site for the erection of a new condensing plant and creamery.

The Henschel Manufacturing Company, Milwaukee, Wis., making cigar and paper boxes, has had plans drawn for a new four-story building.

The plant of the Beatrice (Neb.) Electric Light Company has been purchased by E. J. Sullivan, of Omaha, who will make extensive improvements.

The Blaugas Company of America, 100 Broadway, New York, is planning the establishment of a plant in the Central West for the manufacture of its gas.

The Onn Lumber and Shingle Company, Tacoma, Wash., is planning to erect a new mill to replace the one burned recently. This is to cost about $100,000.

The Union Fishermen's Co-Operative Packing Company, Astoria, Ore., will erect a cannery and cold-storage plant in the new town of Wheeler on Nehalem bay.

The F. Brigham & Gregory Company, Hudson, Mass., will increase its lighting plant from 500 lights to 1000 and is in the market for new or second-hand machines.

The Massillon Sand and Stone Company has commenced work at Barrs Mills, Ohio, on what is claimed, will be the largest molding-sand plant in the United States.

The Pennsylvania Salt Manufacturing Co., Philadelphia, Penn., has taken out a permit for a two-story factory on Porter street, near Weecacoe avenue, to cost $13,500.

It is stated the Pennsylvania Dyeing and Bleach Works, New Cumberland, Penn., is considering the erection of a large new bleachery in the Middle Atlantic section.

The Oklahoma City (Okla.) Bag and Cotton Mills is preparing to erect buildings. The company has recently been formed and will, it is said, invest $1,000,000 in the enterprise.

Plans have been filed for a temporary boiler house in the rear of the Hotel Manhattan, Forty-third street and Madison avenue, New York, for the James J. Belden estate. This is to cost $25,000.

Proposals will be received at the War Department, office of chief sign officer, Washington, D. C., until August 5, for furnishing two 10-kilowat transformers and one 3-kilowatt transformer. A. S. Cowan, disbursing officer.

The Isthmian Canal Commission, Washington, D. C., will receive bids up to 10:30 a.m., August 19, for steel castings, manganese steel bushings, steel, iron, brass condenser tubes, cast-iron pipe, sluice-gate valves, pumps, etc., as per Circular No. 598.

Norcross Bros. Company, 160 Fifth avenue, New York, is reported to have purchased the Masterson marble quarry, at Tuckahoe, N. Y., with a view to operating same again after being shut down for a number of years, or build a plant for manufacturing rock cement.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open bids August 2, as follows: Two thousand pounds aluminum, 8000 naval bronze, 40,000 pounds round machine steel (schedule 2718), 11,100 pounds naval rolled rod brass (schedule 2725), 26,800 pounds medium bar steel, 2000 pounds galvanized sheet steel, 6000 pounds crucible carbon tool steel (schedule 2723).

The Wolverine Motor Car Company, of Mt. Clemens, Mich., has been absorbed by the Alpena Motor Car Company, of Alpena, Mich., D. D. Hanover is president; Wm. Krebs, vice-president; W. B. Robeson, secretary-treasurer; C. H. Munneley, purchasing agent, and H. G. Schworppe, engineer and master mechanic. The company is now building its plant and will shortly be in the market for special tools and labor-saving machinery and appliances common to automobile factories.

The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will open the following bids: August 2—Four steam jacketed copper kettles (schedule 2724), 41,740 pounds crucible cast-steel wire (schedule 2722), 242 interior fittings for mercurial thermostats (schedule 2727), nine transformers (schedule 2716), three transformers (schedule 2717), 65,000 steel balls, 84 steel boiler clamps (schedule 2718), hack-saw blades, twist drills, wood screws, machinists' hand taps, wrenches (schedule 2722), differential pulley blocks (schedule 2718).

NEW INCORPORATIONS

Argo Electric Vehicle Company, Saginaw, Mich. Capital, $200,000. Incorporators, Theo. Huss, Fred Buck, B. Hancheft.

La Marr Aero Company, Frankfort, Ind. Manufacture aëroplanes. Capital, $50,000. W. B. Adams, president; Perry Gable, secretary.

James Foundry Company, Clyde, Ohio. Foundry and machine shops. Capital, $50,000. Incorporators, C. D. James, W. Adare, H. M. Baker, etc.

Crown Gas Light Company, New York. Manufacture gas fixtures. Capital, $50,000. Incorporators, H. Amerman, F. W. Marshall, M. Morrison.

E. L. Comb Company, Leominster, Mass. Manufacture combs, etc. Capital, $10,000. Incorporators, Elbridge Lancey, John Q. Edgerly, etc.

Roller Drive Company, New York. Manufacture machinery. Capital, $100,000. Incorporators, Romeyn Berry, Harper Sibley, Timothy Daly.

United Stove and Repair Company, Brooklyn, N. Y. Manufacture stoves, etc. Capital, $50,000. Incorporators, J. Muerer, A. Muerer, C. H Bolles, Jr.

Forth Motor Car Company, Mansfield, Ohio. Manufacture motor cars. Capital, $200,000. Incorporators, C. S. Ashbrook, W. M. Hahn, Chas. Hoffman, etc.

Independent Owners' Garage, Jersey City, N. J. Operate automobile garages. Capital, $300,000. Incorporators, E. L. Young, E. O. Edwards, E. F. Smith.

C. & L. Manufacturing Company, Chelsea, Mass. Manufacture machinery. Capital, $50,000. President, Karl G. List; treasurer, W. M. Conrad, Chelsea.

Newark Machine Company, Newark, N. J. General machine shop. Capital, $50,000. Incorporators, J. H. Gay, East Orange; H. S. Gay, C. P. Day, Newark.

W. M. P. Motor Company, New York. Manufacture motors. Capital, $50,000. Incorporators, L. R. Walton, F. D. Preston, New York; L. R. Moody, Bayside, L. I.

Larsen Ice Machine Company, Chicago, Ill. Manufacture and deal in machines, etc. Capital, $25,000. Incorporators, J. M. Larsen, J. B. Anderson, O. B. Ryden.

Jackson Wire Company, Millbury, Mass. Manufacture wire. Capital, $10,000. Incorporators, George W. Jackson, Wm. J. Hall, C. R. S. Jackson, all of Worcester.

Grafton Manufacturing Company, Martin's Ferry, Ohio. Smelt and refine metals. Capital, $15,000. Incorporators, W. S. Grafton, F. H. Grafton, P. Dougherty, etc.

Staple Post Company, Westerville, Ohio. Manufacture cement posts, etc. Capital, $50,000. Incorporators, W. B. Johnston, J. P. Montz, C. S. Pillington, etc.

Pacific Manufacturing Company, Portland, Ore. Manufacture wrapping machines, etc. Capital, $15,000. Incorporators, Clarence C. Page, Robert Tucker, C. J. Wellman.

National Electric Porcelain Company, Carey, Ohio. Manufacture porcelain products. Capital, $50,000. Incorporators, J. D. Ewing, H. T. Graves, W. H. Snyder, etc.

High Grade Foundries Company, Borough of Queens, N. Y. Manufacture iron, steel, brass, etc. Capital, $50,000. Incorporators, J. L. Snyder, C. E. McMahon, D. F. Price.

Halldow Manufacturing Company, Elyria, Ohio. Manufacture electric horns, etc. Capital, $20,000. Incorporators, E. L. Smallwood, M. J. Fummington, John Halldow, etc.

Youngstown Trunk Manufacturing Company, Youngstown, Ohio. Manufacture trunks, valises, etc. Capital, $10,000. Incorporators, Louis Knell, Israel Knell, A. Glickman, etc.

Buckeye Dental Supply Company, Toledo, Ohio. Manufacture dental and surgical appliances. Capital, $50,000. Incorporators, Fred A. Kotts, J. C. Good, W. F. Scott, etc.

Chicago Air Brake Company, Chicago, Ill. Manufacture and deal in locomotives, railroad apparatus, etc. Capital, $10,000. Incorporators, A. L. Meyers, S. Lyon, David Jetzinger.

Louisberg Company, Boston, Mass. Manufacture pins, hooks, etc. Capital, $25,000. Incorporators, Edmund Heard, 20 Louisberg Square; John H. Sherman, 53 State street, Boston, etc.

National Electric Enameling Company, New York. Manufacture brick tiles, earthware, etc. Capital, $200,000. Incorporators, Merritt H. Rice, Chas. E. Harvey, Francis A. Woodward, New Rochelle, N. Y.

Balotin - Drabkin Furniture Company, Youngstown, Ohio. Manufacture and deal in house furniture, stoves, etc. Capital, $10,000. Incorporators, Samuel Drabkin, A. B. Livingstone, H. R. Hartzell, Barney Balotin.

Matthew J. Hansen, Inc., New York. Manufacture wagons, vehicles, etc. Capital, $10,000. Incorporators, Matthew J. Hansen, 142 West Sixteenth street; T. J. Moffitt, 316 West Fourteenth street, New York, etc.

Garver Track Laying Machine Company, Urbana, Ill. Manufacture and operate track-laying machines, constructing railways. Capital, $50,000. Incorporators, Taylor M. Garver, Oliver W. Lamb, Harvey M. Grant.

National Envelope Sealing and Stamping Manufacturing Company, Boston, Mass. Manufacture envelope-sealing machines. Capital, $500,000. Incorporators, Eugene F. Bowen, Providence, R. I.; Arthur P. Turner, Lexington, Mass., etc.

Lawson Piano Company, Bronx, N. Y. Manufacture pianos, etc. Capital, $250,000. In

corporators, Frank Lawson, 746 Forty-third street, M. De Grove, 337 Fourteenth street, Brooklyn, N. Y.; R. Warren Lawrence, 348 East One Hundred and Fortieth street, New York.

Business Items

The Taft-Peirce Manufacturing Company, Woonsocket, R. I., announce the opening of an office in Detroit, Mich., in the Majestic building.

The Miami Valley Machine Tool Company, Dayton, Ohio, has recently completed an addition to its plant, increasing considerably the floor space for assembling purposes and thus making for larger output.

Joseph T. Ryerson & Son, Chicago, Ill., have moved their New York office to the seventh floor of the Hudson Terminal building, 30 Church street. They maintain in connection with this, display rooms and warehouses immediately adjacent to the Jersey City terminal of the Hudson & Manhattan tunnel.

The Wright Wrench Manufacturing Company, Canton, Ohio, has changed its name to the Wright Wrench and Forging Company. This company has just moved into its large new factory, which gives ample room for increased production. Its new plant includes a forging department and it is prepared to take care of a general forging business in addition to the manufacture of its quick-adjustable wrenches.

The Keuffel & Esser Company, Hoboken, N. J., celebrated the forty-third anniversary of the founding of the house, by a banquet to its employees, on July 19. Interest was added to the occasion by the fact that four employees this year complete their twenty-fifth year of service with the company. Appropriate gifts were presented to them by the firm, and some very handsome testimonials given by their fellow workmen. The unusual spectacle of twelve veteran employees who have completed a quarter of a century service with the company, occupying the places of honor with the officers of the company, was an inspiration to the 500 younger employees present.

Forthcoming Meetings

Joint meeting of American Society of Mechanical Engineers and Institution of Mechanical Engineers, Birmingham, England, July 26-29, 1910.

Society of Automobile Engineers, convention of designers and superintendents, July 28, 29 and 30, Detroit, Mich. H. E. Coffin, president 1451 Broadway, New York City.

American Society of Mechanical Engineers; monthly meeting second Tuesday. Calvin W. Rice, secretary, 29 West Thirty-ninth street, New York City.

Boston Branch National Metal Trades Association. Monthly meeting on first Wednesday of each month, Young's hotel. D. F. P. Clark, secretary, 309 Milk street, Boston, Mass.

Providence Association of Mechanical Engineers. Monthly meeting fourth Tuesday each month. E. C. Bliss, president, 91 Sabine street, Providence, R. I.

New England Foundrymen's Association; regular meeting second Wednesday of each month, Exchange Club, Boston, Mass. Fred F. Stockwell, 205 Broadway, Cambridgeport, Mass.

Engineers' Society of Western Pennsylvania; monthly meeting third Tuesday. Elmer K. Hiles, secretary, Fulton building, Pittsburg, Penn.

Superintendents' and Foremen's Club of Cleveland; monthly meeting third Saturday. Philip Frankel, secretary, 310 New England building, Cleveland, O.

Western Society of Engineers, Chicago, Ill. Regular meeting first Wednesday evening of each month, excepting July and August. Secretary, J. H. Warder, 1735 Monadnock block, Chicago, Ill.

WANTS

Rate 25 cents per line for each insertion. About six words make a line. No advertisements abbreviated. Copy should be sent to reach us not later than Friday for ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. No information given by us regarding any advertiser using box number. Original letters of recommendations or other papers of value should not be inclosed to unknown correspondents. Only bona-fide advertisements inserted under this heading. No advertising accepted from any agency, association or individual charging a fee for "registration," or a commission on wages of successful applicants for situations.

Miscellaneous Wants

Caliper catalog free. E.G.Smith, Columbia, Pa.

We buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Wanted—Work for screw machines and gear cutter. Box 775, AMERICAN MACHINIST.

Light, fine machinery to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

If you want special machinery or tools designed, I can give you satisfactory service. Box 694, AMERICAN MACHINIST.

Special machinery accurately built. Screw machine or turret lathe work solicited. Robert J. Emory & Co., Newark, N. J.

Light and medium weight machinery and duplicate parts built to order; tools, jigs, etc. MacCordy Mfg. Co., Amsterdam, N. Y.

Patents. C. L. Parker, Patent Attorney, ex-examiner Patent Office, 990 G St., Washington, D. C. Write for Inventor's Handbook.

Wanted—Country shop, within 100 miles of New York, to build a 200-pound machine; about 50 to 100 wanted per year. Box 776, AMERICAN MACHINIST.

Light, fine machinery and mechanical specialties built to order; jigs, tools, etc., designed and built. Goodson Electric and Manufacturing Co., Providence, R. I.

A well equipped machine shop within 30 miles from New York solicits orders for all kinds of machine work. Send inquiries: The Brunswick Refrigerating Co., New Brunswick, N. J.

Light or medium weight machinery to manufacture on contract or special machinery to build. Box 734, AMERICAN MACHINIST.

A large English firm of machine-tool importers having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Wanted—A second-hand engine, lathe swinging 24 inches over the carriage, from 11 to 14 feet between centers; must be strong and accurate; suitable for mill work. Address Thompson & Norris Co., Brookville, Ind.

Old established concern doing an annual business of $500,000 in sheet steel specialties, needs additional working capital to handle increasing business; would consider combination with responsible concern having ample capital and wishing to increase its sales. Box 780, AMERICAN MACHINIST.

Wanted—Autogenous welding work; we weld (not braze) cracked or broken parts of cast iron, aluminum, brass, etc., by oxy-acetylene process; let us send you further information and references; you pay for successful repairs only; try us and be convinced. Waterbury Welding Works, Waterbury, Conn.

Help Wanted

Classification indicates present address of advertiser, nothing else.

COLORADO

Due to the steady increase of our business, we are constantly in need of drill press, lathe, planer, grinder, Jones & Lamson and bench men; also toolmakers and tool smiths; good climate and location; steady work, good pay to first-class men; shop clean, light and well ventilated; 9 hours work. Address, stating experience. J. Geo. Leyner Engineering Works Co., Littleton, Colo.

CONNECTICUT

Wanted—We want a machine salesman to cover territory in and around New York City; standard machine that is used in all factories. Address P. O. Box 685, Waterbury, Conn.

Wanted—Salesmen to handle on a generous commission basis, a well advertised and quick selling line of lathe tools; commissions given on all orders received from prescribed territory; send references with reply. Address "R. T.," AMERICAN MACHINIST.

ILLINOIS

Wanted—By agricultural implement manufacturer in central Illinois, a draftsman to take charge of drafting room, also wood and metal patternmakers who are rapid and accurate. Address Implement Manufacturer, AMERICAN MACHINIST.

INDIANA

Situation open in Middle West to draftsman experienced in threshing machinery. Box 774, AMERICAN MACHINIST.

Wanted—First-class automobile draftsman with some executive ability, capable of directing 12 or 15 men. Box 763, AM. MACH.

Wanted—First-class all-around machine operator to do time setting for premium system for large automobile company with machine shop employing 700 men; none but first-class men need apply. Box 772, AMER. MACH.

Wanted—Foreman to take charge of assembling and testing department in one of the most modern, uptodate automobile engine shops in the country; product is thoroughly established and the job will be steady for the right man; none but men who have had experience as foreman and who can furnish first-class references need apply. For full particulars address "Motor Assembler," Care AMERICAN MACHINIST.

IOWA

Shop Instructor Wanted—An intelligent man familiar with shop methods and himself a thorough machinist is wanted to take charge of shop instruction in the shops of the College of Applied Science, State University of Iowa, at Iowa City; the shops are new and new equipment is being purchased; salary $900 to begin with, payable in 10 installments for 9 months' work; advancement is assured to the right man. Address Wm. G. Raymond, Dean, Iowa City, Iowa.

MARYLAND

Wanted—A first-class general foreman for safe and vault manufacture; must understand the work and know how to handle men. Box 785, AMERICAN MACHINIST.

Wanted—Foreman for paint shop by manufacturers of fireproof safes and vaults; must understand the work thoroughly and be able to handle men. Box 786, AM. MACH.

MASSACHUSETTS

Wanted—Toolmakers, experienced on punch and die work. Apply Employment Department, General Electric Co., Pittsfield, Mass.

Wanted — Experienced mechanical draftsman and designer for permanent position with large manufacturing concern in Massachusetts; state age, education, experience and salary expected by addressing Chief Draftsman, Box 778, AMERICAN MACHINIST.

Wanted—A man with capital desiring to invest in a sure going proposition in the machine tool manufacturing line, with view of taking the position as manager of the company; might be able to secure the controlling interest; this is a high-class proposition, and a prospective purchaser would need to command from $40,000 to $50,000. Box 781, AMERICAN MACHINIST.

MICHIGAN

Machinists—Men experienced at assembling the mechanism of crane bridges. Box 183, Detroit, Mich.

Wanted—A few first-class toolmakers experienced on die, jig and fixture work for light manufacturing. Box 592, AM. MACH.

NEW JERSEY

Wanted—A-1 automatic operator on Cleveland machines; must be well recommended. Hartford Suspension Co., 156 Bay St., Jersey City, N. J.

Superintendent for machine shop wanted for large works in vicinity of New York City; must have had at least five years' experience in similar position and have handled all classes of machine work. Box 795, AM. MA.

Wanted—A competent and reliable automatic screw operator, one who has been accustomed to the Acme and Brown & Sharpe machines preferred; none but first-class men need apply; steady work and good pay. Apply at the works of Henry R. Worthington, Harrison, N. J.

NEW YORK

Wanted—First-class drop forgings die sinkers; shop surroundings particularly desirable. Box 755, AMERICAN MACHINIST.

Patternmaker, first-class on wood patterns; good pay and steady work to competent man; give age, experience and references; vicinity of New York. Box 768, AMER. MACHINIST.

Wanted — An experienced case-hardener; one who understands the business thoroughly; good pay and steady employment; state age, experience and salary expected. Eclipse Machine Co., Elmira, N. Y.

Wanted—First-class lathe, drill press and milling machine operators for both night and day work; state past experience, wage demanded and complete information in first letter. The Kirkham Motor Mfg. Co., Bath, N. Y.

Salesmen on a generous commission basis, competent, practical tool dressers or others capable of demonstrating the merits of the most successful steel hardening solution ever sold; five years' continuous use by responsible firms vouches for its value wherever water-hardening steels are in use. Box 760, AM. M.

Wanted—We are constantly increasing our force and invite applications from the following: Machinists, lathe hands, screw machine hands, grinder hands, milling machine hands, motor assemblers, toolmakers, sheet metal die men; we run a nine-hour shop, have desirable surroundings, and offer steady position to desirable characters. Address Superintendent, Maxwell-Briscoe Motor Co., Tarrytown, N. Y.

OHIO

Molders wanted on light machinery in Ohio. Box 769, AMERICAN MACHINIST.

Wanted—Several first-class draftsmen with experience on crane work; none others need apply; state age, experience and salary. Box 727, AMERICAN MACHINIST.

Wanted—By a manufacturing concern in Ohio, building general machinery, a foreman for milling and gear-cutting department; also an expert toolmaker; give age, experience, and salary wanted. N-1, AMER. MACHINIST.

Wanted—Chief draftsman to take charge of large engineering office; must have good technical and practical training, executive ability and capable of systematizing office and getting output; good opening with opportunity for advancement; state qualifications fully in writing. Box 753, AMER. MACH.

Wanted—A Cincinnati concern want a thoroughly competent and experienced mechanical designer with some knowledge of electrical work; no other need apply; permanent position and chance for advancement to right man; state experience and give references; salary at start $100 per month. Box 733, AMERICAN MACHINIST.

Wanted—We are constantly increasing our force and invite applications from the following: Machinists, lathe hands, screw machine hands, milling machine hand, Jones & Lamson turret lathe hand, planer hand, and vise hands for tool room and erecting shop, erectors on heavy machinery; shop located in a desirable city in southern Ohio; steady positions to men who prove satisfactory; open shop, no labor troubles. "A. B. C.," AM. MA.

Wanted—First-class machinists, toolmakers die sinkers, lathe, planer, drill press, screw machine, boring and milling machine operators, wood patternmakers, brass molders, polishers, buffers, finishers, spinners, millwrights, hammermen and blacksmiths who are seeking positions or desirous of improving on those which they have, to register their names and addresses with the free Employment Department of the National Metal Trades Association. Address Commissioner's Office, 605 New England Bldg., Cleveland, O.

PENNSYLVANIA

Wanted—Floor hands and fitters on machine tool work. Colburn Machine Tool Co., Franklin, Penn.

Wanted—Lathe, boring mill and floor hands; good wages, steady work. The Blaisdell Machinery Company, Bradford, Penn.

Wanted—Machine shop foreman accustomed to machine tool manufacture on economical lines and designer of jigs for same; state age, experience and salary; correspondence confidential. Box 758, AMERICAN MACHINIST.

Wanted—First-class foreman for machine work; must be a man of ability in handling help and be able to show a satisfactory record as a foreman; to a man capable of filling this position satisfactorily, we will pay $100 per month. Box 777, AMERICAN MACHINIST.

Foreman—Press room foreman (in Philadelphia) to take charge of department having double and single-acting stamping and drawing presses; must especially be an economical producer and disciplinarian with undoubted ability in handling men; thorough knowledge of dies also important; dandy opportunity for a managing hustler; give age, experience and salary expected. Box 756, AMER. MACH.

The Monotype School is maintained to train young men to meet the constant demand for operators of our type casting and composing machine; these operators do so well that we receive more applications for places than can be filled; these qualifications carry most weight: Common sense, automatic machinery experience, printing office experience, type foundry experience. Full particulars will be furnished to inquirers who furnish the same information about themselves, and mention this paper. Lanston Monotype Machine Co., Philadelphia.

WASHINGTON

Wanted—By large engineering works in Seattle, Wash., engaged in marine and land work, first-class engineering draftsman who has had experience in designing machinery and boilers; none but first rate men need apply; references required. P. O. Box 1905, Seattle, Wash.

WISCONSIN

Wanted—General foreman for well equipped shop, making small machines; good executive; experienced in economical production. Milwaukee. Box 754, AMERICAN MACHINIST.

Shop man who understands the rapid and accurate production of small, interchangeable parts, and who has a good knowledge of production of stampings; must be sober, energetic and good mechanic; state age, experience, salary expected, where employed at present, and reasons for desiring a change. "X Y Z," AMERICAN MACHINIST.

SITUATIONS WANTED

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Detail draftsman would like to make change; can furnish good recommendation. Address C. A. Earle, P. O. Box 73, Waterville, Conn.

ILLINOIS

Experienced, practical, systematic, superintendent in charge of a large manufacturing plant, wishes to make a change. Box 686, AMERICAN MACHINIST.

MASSACHUSETTS

Superintendent of a large manufacturing plant, with wide experience on automatic and labor saving devices, desires making a change. Box 788, AMERICAN MACHINIST.

Responsible position desired by superintendent of broad experience on designing and manufacturing medium and light machinery; expert on tool designing and experimental work. Box 773, AMERICAN MACHINIST.

MISSOURI

Superintendent or general foreman, now employed, desires change; experience in modern shop methods, manufacturing small and medium interchangeable parts; good reliable mechanic. Box 790, AMERICAN MACHINIST.

NEW YORK

Draftsman, good, experienced, seeks position anywhere. Box 793, AMER. MACHINIST.

Graduate mechanical engineer, one year's shop and six years' designing experience, desires change. Box 794, AMER. MACHINIST.

Foreman, tool and die, or machinist; practical, executive, reliable, systematic; New York City, suburbs. Box 796, AM. MACH.

Mechanical graduate, experienced, practical tool and die maker; familiar and up to date in die castings. Box 782, AMER. MACH.

Superintendent of construction, power house, factory or shop work; reliable, good executive ability, large experience. Box 783, AMERICAN MACHINIST.

Practical and technical man; successful superintendent, executive and mechanical, shop and foundry, general and duplicate work; splendid references. Box 740, AM. M.

General foreman, middle age, now employed, latest methods, engineering, electrical and general manufacturing; A-1 hustler; can handle force with executive ability. Box 762, AMERICAN MACHINIST.

Superintendent or works manager with wide, practical experience on tools, dies and general manufacturing; systematic organizer and executive; no proposition too large; location no object. Box 787, AMER. MACH.

Position as general foreman or superintendent by first-class mechanic, thoroughly up to date on all makes of automatic and semi-automatic machines; can furnish best of references as to mechanical and executive ability. "Producer," AMERICAN MACHINIST.

Machinist, German, master mechanic with A-1 references as to character and capabilities, 42 years of age, 26 years' practical and theoretical experience as draftsman, experimental worker, tool and die maker, automatic machinery and interchangeable work, also foreman and superintendent knowledge, wants position as foreman or any responsible situation. Box 789, AMERICAN MACHINIST.

PENNSYLVANIA

Tool designer and machinist, technical graduate, desires position as salesman of machine tools. Box 784, AMERICAN MACHINIST.

Position wanted as superintendent or foreman with a reliable firm in the manufacturing of plumbing supplies, general brass and iron goods; have 18 years' experience; familiar with uptodate tools and machines; a hustler; sober and steady practical mechanic; A-1 references; city or country. Box 723, AMERICAN MACHINIST.

Foundry and machine shop superintendent, experienced in both branches, also in general office practice, systematizing, etc.; qualified to take entire charge of plant as works manager or superintendent; eighteen years' experience on pumps, valves and general machinery; good reasons for changing and excellent references. Box 752, AMER. MACH.

Expert designer (35), 14 years' designing and constructing general machinery, including marine and stationary engines, boilers, auxiliaries, dredging machinery a specialty, rolling mill equipment, etc., thoroughly conversant with best pattern, foundry and shop practice, large experience estimating costs, have technical education and am a successful executive, can take entire charge in office or field, for ten years chief draftsman of prominent concern, now desires change; will accept responsible position with first-class growing firm. Box 791, AMER. MACHINIST.

UTAH

Toolmaker, energetic man, extensive experience, die tool work, interchangeable manufacturing, seeking position; age 30. Care of Berger, 337 East 7th South St., Salt Lake City, Utah.

WISCONSIN

Situation wanted by mechanical and experimental engineer; experienced on special automatic machinery design and perfection; eighteen years' shop and office experience; present position superintendent. Box 779, AMERICAN MACHINIST.

FOR SALE

For Sale—Interest or control in manufacturing business; exceptional opportunity for manager or instrument maker. Box 516, AMERICAN MACHINIST.

For Sale—In rapidly growing town in Vermont, at the junction of two railroads, six hours from Boston, a modern three-story factory building, 27,000 feet, steam heat and sprinkler system, electric lighted, one-half acre land, $5000. Box 792, AMER. MACH.

For Sale—Full working drawings of a three cylinder 5½"x7½", four cycle, latest improved marine engine, complete with direct driven water and oil pumps and air compressor; money maker for machine shop wanting high class engine to build. Beck & Sargent, Engineers, 152 Lake St., Chicago, Ill.

For Sale—Three return tubular boilers, manufactured by Riter Bros., Buffalo, N. Y. Drums 72x16 feet 0 inches; each boiler with sixty-six 4-inch tubes; inspected by Travelers Indemnity Company, of Hartford, Conn; 93 lb. steam pressure; boilers in good condition; can be delivered in two to three months, and seen in operation at Buffalo Bolt Company's plant, North Tonawanda, N. Y.

An opportunity to start a machine shop; we offer one of our departments for sale, the one used to establish our business; it is small and profitable work, but as we are devoting ourselves to heavier work, we offer to sell for $2000, all the drawings, patterns, and stock of finished and partly finished parts and rough material (inventories over $3000), circulars, electrotypes, special machinery and fixtures, and an established trade. Address Sipp Machine Company, Paterson, N. J.

For Sale—One Nash gas engine, 20 horsepower, two cylinder, for electric lighting, pumping or power; one Beaman & Smith horizontal boring mill; table 25 inches wide, 36 inches long; will bore 12 inches diameter, 24 inches long, and face 20 inches diameter; one 300 light J. B. Colt Co. acetylene gas apparatus. The above machines are in excellent condition, having been very little used. For further particulars and prices apply to Rider-Ericsson Engine Co., 35 Warren St., New York.

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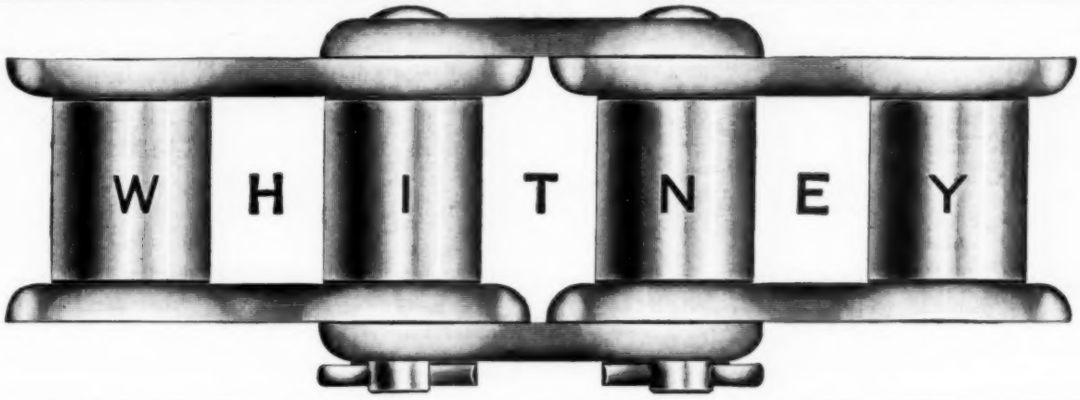
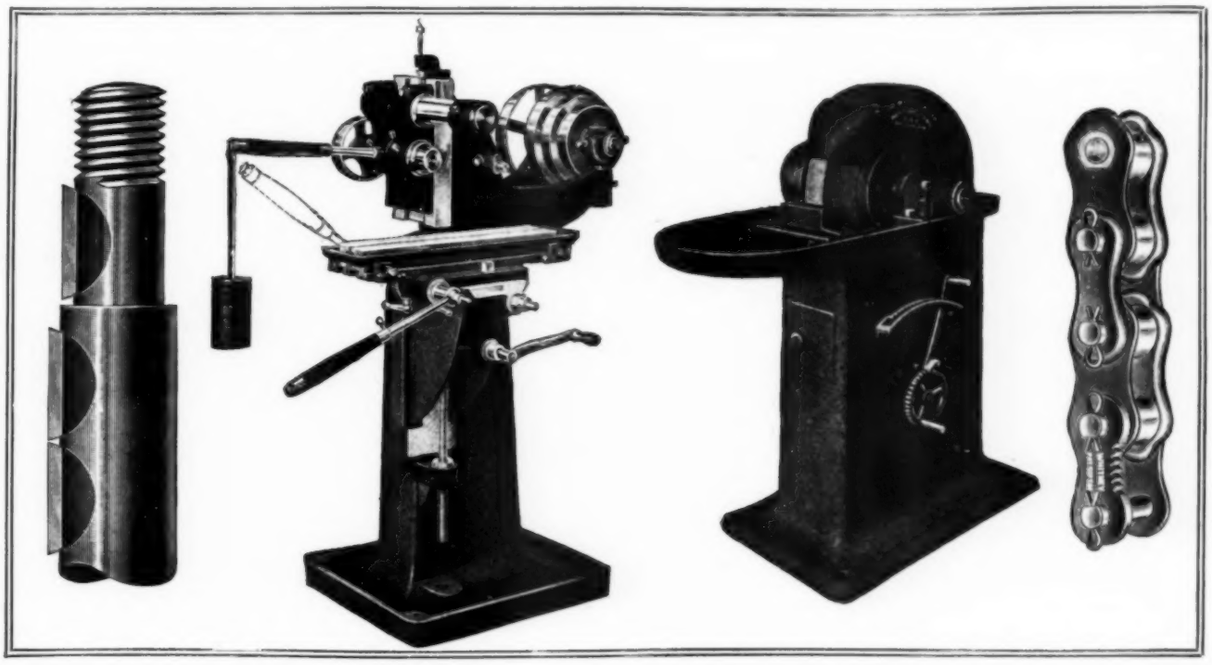


Chain Department

Roller Chains, Block Chains, Chain Belts, Quiet Chains, for Automobiles, Commercial Cars, Motorcycles, Bicycles, Machinery, etc.

Machine Department

Hand (feed) Milling Machines, 20-inch Water Tool Grinders, Keys and Cutters for the Woodruff Patent System of Keying, Presto Drill Chucks, Collets and Friction Tapping Devices.



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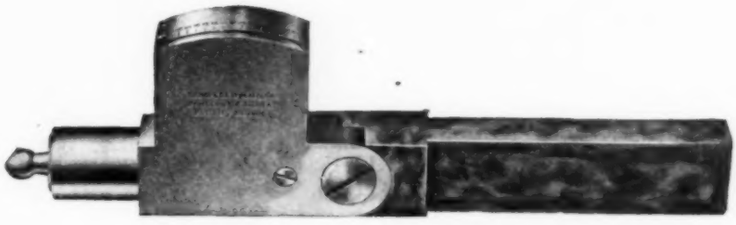
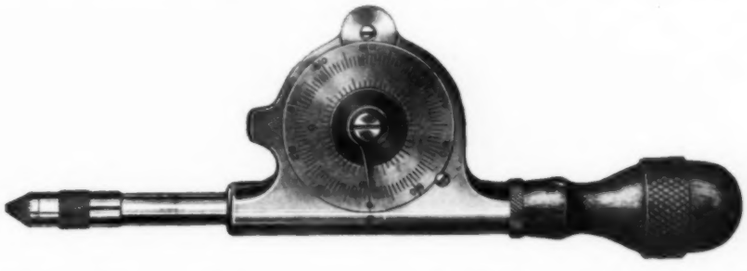
These two Indicators, a part of our complete line, are accurate instruments for detecting errors.



B. & S. Indicator

Accurate readings can be obtained with this indicator from any direction, a distinctive feature made possible by the point. This is hardened and ground spherical, thus permitting pressure to be brought from any direction. On account of this feature there is no necessity of securing an accurate setting of the indicator in the tool post before taking readings.

A wide variety of work can be done by the indicator as it is used to set centrally any point or hole, for testing lathe centres and work of a similar nature.



B. & S. Speed Indicator

A quick re-adjustment of the indicator after a reading has been obtained is an exclusive feature of this tool. It is secured by means of the small knurled wheel on the top of the case which will quickly revert the rotating disk to zero, thus saving the time formerly wasted by turning the spindle by hand.

Another exclusive feature is the fact that it registers on either side. Thus, shafts which are revolving in one direction have their speed shown on one side, while the speed of those revolving in the other direction is recorded on the opposite side. The indicator registers up to 5000 revolutions per minute.

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Erecting Department

A Look Into The Plant Where Landis Grinders Are Made——

The pictures give some idea of the size of our plant. It takes a plant of great size to fill the demand for Landis Grinders. If you are interested in Grinding write for Catalog A. Send samples or sketches and let us estimate.

Landis Tool Company, Waynesboro, Pa.

New York Office, Fulton Building, 50 Church St., Walter H. Foster & Co., Managers.

AGENTS—C. W. Burton, Griffiths & Co., London and Glasgow. Schuchardt & Schutte, Berlin, Vienna, Stockholm, St. Petersburg, Copenhagen and Budapest. Alfred H. Schutte, Cologne, Brussels, Liege, Milan, Paris, Barcelona, and Bilbao. A. R. Williams Machinery Co., Toronto. Williams & Wilson, Montreal, Canada.

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Improved Tool Grinding Machines

Manufactured By

The Morse Twist Drill & Machine Co.,

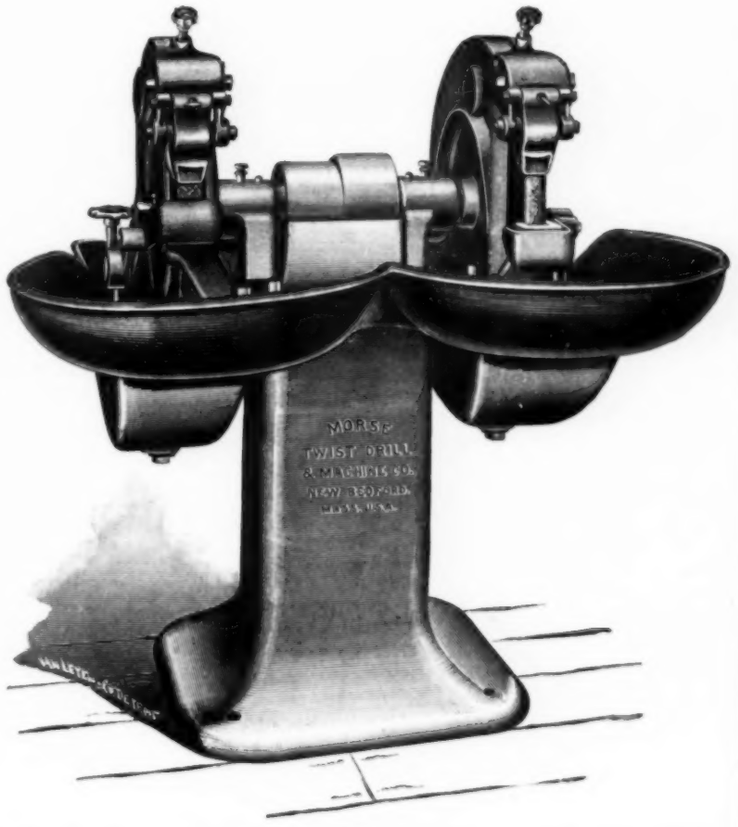
New Bedford, Mass., U. S. A.

Dimensions of No. 2 Tool Grinder

The Bearings are 2⅜" diameter, 8" long. The Emery Wheels are 24" diameter, 1½" face. The distance between Emery Wheels is 25½". The Machine, crated for shipment, weighs 1750 lbs. The proper speed for Countershaft is 440 revolutions per minute. This gives 716 revolutions per minute for Wheel Spindle.

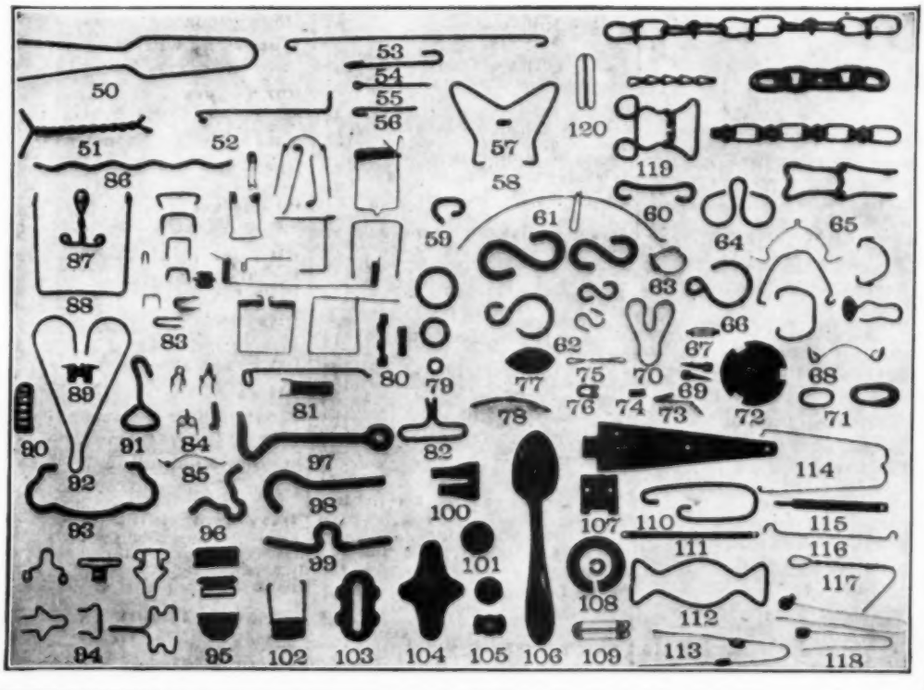
We also make a Single Wheel Tool Grinding Machine carrying one 24" wheel.

If Interested, Send For Circular



"The Automatic" line of machinery is made in any special types for turning out innumerable pieces in rapid duplication. The shapes shown below are only a few of the many kinds which are made with wonderful speed and accuracy on "Automatics" Send samples or blue prints for estimates.

50 Wire handle. 51 Twist wire. 52 Special. 53 Links. 54 Links. 55 Screw eye blank. 56 Screw eye blank. 57 Side for bicycle chain link. 58 Special. 59 Dredge link. 60 Link. 61 Neck wire. 62 S. hooks. 63 Hose clamp. 64 Finger ring. 65 Chain. 66 Chain hook. 67 Buckle. 68 Bottle wires. 69 Button fastener. 70 Wire shape. 71 Repair links. 72 Sheet blank. 73 Trap Wire. 74 Umbrella spring. 75 Fish line swivel. 76 Corset fasteners. 77 Fish hook spoon. 78 Spring. 79 Flat and round rings. 80 Umbrella clamp. 81 Mouse and rat trap wires. 82 Belt hook. 83 Staples. 84 Hooks and eyes. 85 Piano wires. 86 Crimped wire. 87 Hook. 88 Trap wire. 89 Eyelet. 90 Shoe fastener. 91 Hook. 92 Special. 93 Drawer or chest handle. 94 Suspender and trouser buckles. 95 Suspender buckle plates. 96 Bottle wire. 97 Iron hook. 98 Blank hammock hook. 99 T bar. 100 File wire holder. 101 Button back. 102 Bottle cap 103 Sheet metal form. 104 Portier pole bracket. 105 Curtain pole plates. 106 Spoon. 107 Hinges. 108 Check washers. 109 Hose supporter. 110 Tie wire. 111 Seal wire. 112 Special shape. 113 Neck wire. 114 Gas mantle wire. 115 Harness wire. 116 Link. 117 Bag tie. 118 Car seals and wires. 119 Belt hook.



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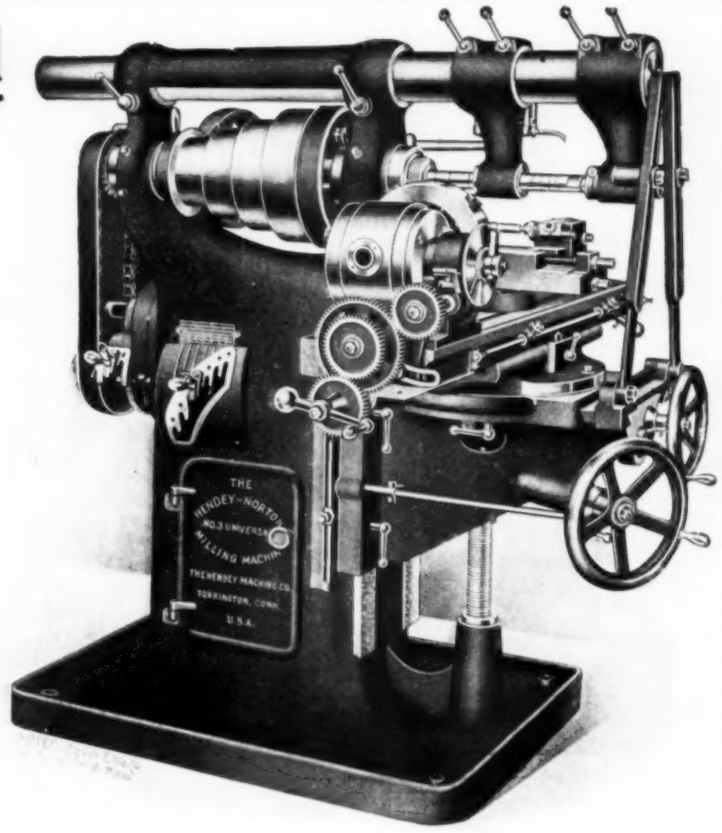

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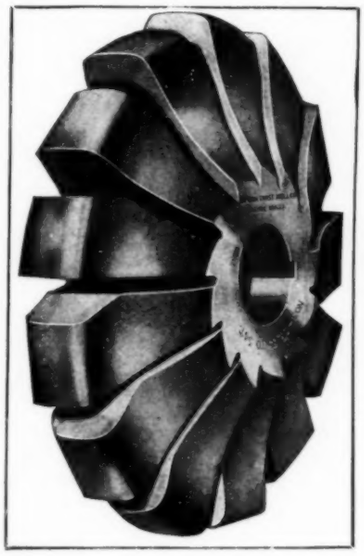

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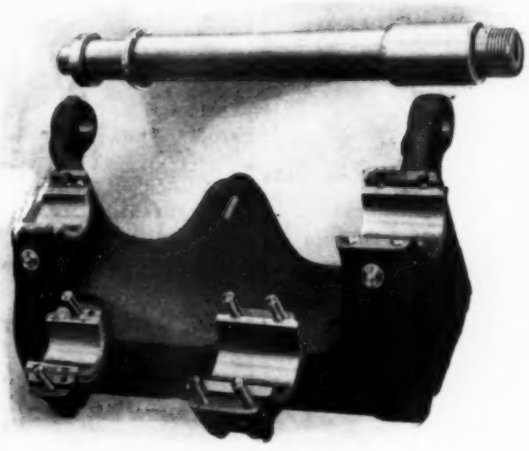

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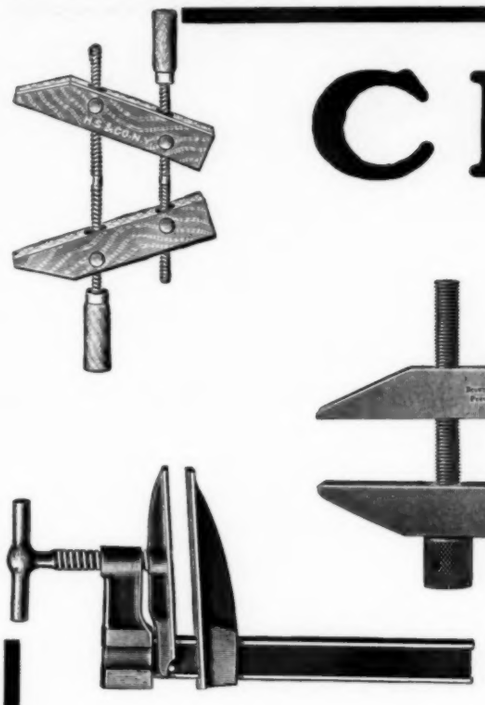

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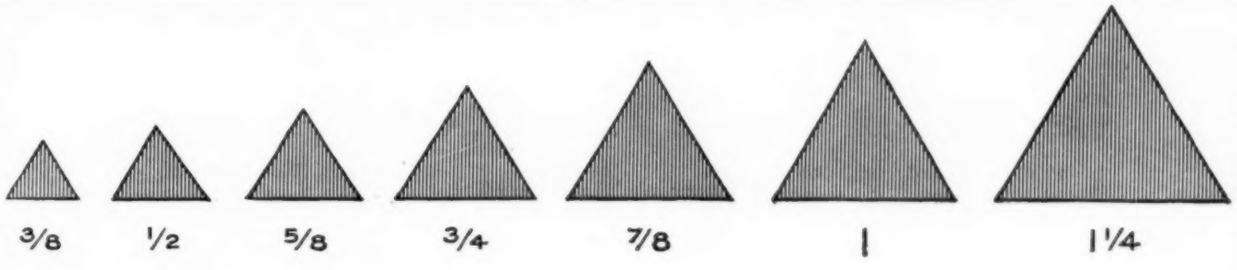

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